EVALUATION OF ROAD PROJECTS INVESTMENT PRIORITIZATION METHODS IN ETHIOPIA

BY

MAKDA MATHEWOS GEBRESELASSIE

A Thesis Submitted To

College of Architecture and Civil Engineering for the Partial Fulfillment of the Requirements for the Degree of Master of Science in Construction Technology & Management

ADDIS ABABA SCIENCE & TECHNOLOGY UNIVERSITY

JANUARY 2018

DECLARATION

I declare that this thesis entitled "EVALUATION OF ROAD PROJECT INVESTMENT PRIORITIZATION METHODS IN ETHIOPIA" is my original work. This thesis has not been presented for any other university and is not concurrently submitted in candidature of any other degree, and that all sources of material used for the thesis have been duly acknowledged.

Name: MakdaMathewosGebreselassieSignature: _____ Date_____

CERTIFICATE

This is to certify that the thesis prepared by **MrsMakdaMathewosGebreselassie**entitled "**Evaluation of Road Projects Investment Prioritization Methods in Ethiopia"** and submitted in fulfillment of the requirements for the Degree of Master of Science in Civil Engineering (COTM) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Date of Defense: February 02, 2018

Principal Advisor	**Signature**	**Date**
Alemayehu Ambo (Ph.D)	_____	/_____ /_____

Members of the Examining Board		**Signature**	**Date**
1. DenamoAddissie (Ph.D)	External Examiner	_____	_____
2. KasiRekha (Ph.D)	Internal Examiner	_____	_____
3. MelakuSisay (Ph.D)	ERA PG, Program Coordinator	_____	
4. Mr. Simon G/EgziabherHead,	Department	_____	_____Civil Engineering
5. Brook Abate (Ph.D)	Dean, College of Architecture and Civil Engineering	_____	_____

Addis Ababa – Ethiopia

ABSTRACT

Project prioritization is widely used globally as a tool to evaluate and rank projects; but the methods differ greatly across nations.Inrelation, this research aims to evaluate the Ethiopian Federal and rural road projects investment prioritization practice. In order to assess the regional/ rural road projects investment prioritization practice, only the Oromia Roads Authority (ORA) was selected due to limitation of time and budget to consider other regions.

Accordingly, a comprehensive literature review was made to highlight the overview of road projects selection and prioritization practice for investment globally, regionally and country-wise. The methodology adopted in this study comprises: interview, document review, and case study through questionnaires survey and desk study.

The research showed that ERA has its own road projects investmentselection methods and prioritization criteria. However, the road projects those are under implementation and planned for implementation are not in line with the given selection methods, which areregional roads authority proposal or ERA's planning requirement. The study also revealed that ORA has some regional/rural road projects investment prioritization criteria, though it is not officially communicated or considered throughout the authority as a guideline. However there is no weighting for each criteria to evaluate all projects in equal ground.

As to the current practice effectiveness, both ERA and ORA roads have very lower degree of positive impacts on public consultation and reduced accident ratethose are considered asthe road selection and prioritization parameter. In addition, the roads especially ERA roads havesignificant negative social and environment impact.It isalso learnt from the research that the gaps identified from Ethiopian road projects selection and prioritization practice for investment are considered as criteria and appropriately implemented in other countries practice, such as Pakistan, Indonesia, Vietnam and Tanzania.

Finally, the research has also forwarded recommendation as mitigation and intervention measures, that the roads authorities should develop new selection and prioritization criteria as to address the identified gaps and should appropriately applied in selection and prioritization of road projects investment.

Keywords: criteria, ERA, Ethiopia, ORA, prioritization and road project.

ACKNOWLEDGEMENTS

First, I would like to express my deep appreciation to my advisor Alemayehu Ambo (Ph.D), Addis Ababa Science and Technology University; for his professional guidance, useful advice, continuous encouragement, and support throughout the process of this research.

I am deeply grateful to all who gave me assistances in obtaining the information and data related to this work. Particular thanks also go to the experts and staff at the Ethiopian and Oromia Roads Authority, and Zonal and Woreda Administrative Office representatives for their willingness to provide me with all the necessary data and apportioning their time to respond to the questionnaire to supply the important and valuable information.

I would like to extend my deepest gratitude to my family and friends, without their love and support this thesis would not have been realized.

Above all, my thanks rise to the Almighty God for giving me the health, strength and endurance.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT: Average Annual Daily Traffic

AC: Asphalt Concrete

B-CR: Benefit-Cost Ratio

CBA: Cost Benefit Analysis

CEA: Cost-Effectiveness Approach

DBST: Double Bituminous Surface Treatment

DS: Design Standard

EFY: Ethiopian Fiscal Year

EIA: Environmental Impact Assessment

EIRR: Economic Internal Rate of Return

ENPV: Economic Net Present Value

ERA: Ethiopian Roads Authority

ERTTP: Ethiopian Rural Travel and Transport Program

ETB: Ethiopian Birr

FDRE: Federal Democratic Republic of Ethiopia

GoE: Government of Ethiopia

GTP: Growth and Transformation Plan

HDM: Highway Design / Development and Maintenance/Management Model

IRI: International Roughness Index

IRR: Internal Rate of Return

MARR: Minimum Attractive Rate of Return

MCA: Multi Criteria Analysis

MCDA:	Multi- Criteria Decision Analysis
MS:	Mean Score
NMT:	Non-Motorized transport
NPV:	Net Present Value
ORA:	Oromia Roads Authority
RAP:	Resettlement Action Plan
RED:	Roads Economic Decision Model
RoW:	Right of Way
RRAs:	Regional/Rural Roads Authorities
RSDP:	Road Sector Development Program
RTI:	Road Transport Infrastructure
SIA:	Social Impact Assessment
SLCA:	Social Life Cycle Assessment
SNNPR:	Southern Nations and Nationalities Peoples Region
URRAP:	Universal Rural Road Access Program
VPD:	Vehicle Per Day
WB:	World Bank
WRO:	Woreda Road Office

CHAPTER ONE
INTRODUCTION

1.1 General

Ethiopia is the second populous country in Sub-Saharan Africa, next to Nigeria and is experiencing fast economic growth accompanied by a huge demand for transportation infrastructures. Despite the inadequacy of different mode of transportation, the sector of road transportation remains the nation's most important means for travel and transportation; and it accounts for more than 95% of the country's domestic passenger and cargo traffic (Ethiopian Roads Authority 1998; Worku 2011).

In the context of Ethiopia, road is the most important infrastructure that provides access to rural and urban areas in the country. Road plays crucial role to reduce transportation cost as well as physical exhaustion of the people and support economic growth in the country. However in the late 1990's; the road network coverage was limited to major urban areas and some rural areas. Most areas in the country were isolated from economic centers, market and basic social services. The existing road network was largely deteriorated and was in poor condition. Hence, the transportation sector was initially developed to contribute to Ethiopia's social and economic development and poverty reduction efforts by providing an efficient transport system, resulting in improved access, increased movement of people and goods, improved agricultural production and marketing, a better access to social and economic facilities, and increased economic exploitation of the natural resources, amongst others.

The Government of Ethiopia has well recognized that limited road network coverage and poor condition of the existing road network has been an impediment to economic recovery and growth. Therefore, to address the problems in the road sector; the Government launched the Road Sector Development Program (RSDP) in 1997. Since then, with considerable support from the development partners, it has successively implemented three phases having each a 5 year duration. In general, the objective of

the RSDP was to expand the road transport infrastructure and to improve the existing network through upgrading and road maintenance as well as building domestic contracting capacity. (ERA, RSDP 2016)

Figure 1.1below illustrates the Ethiopian road network in 2016.

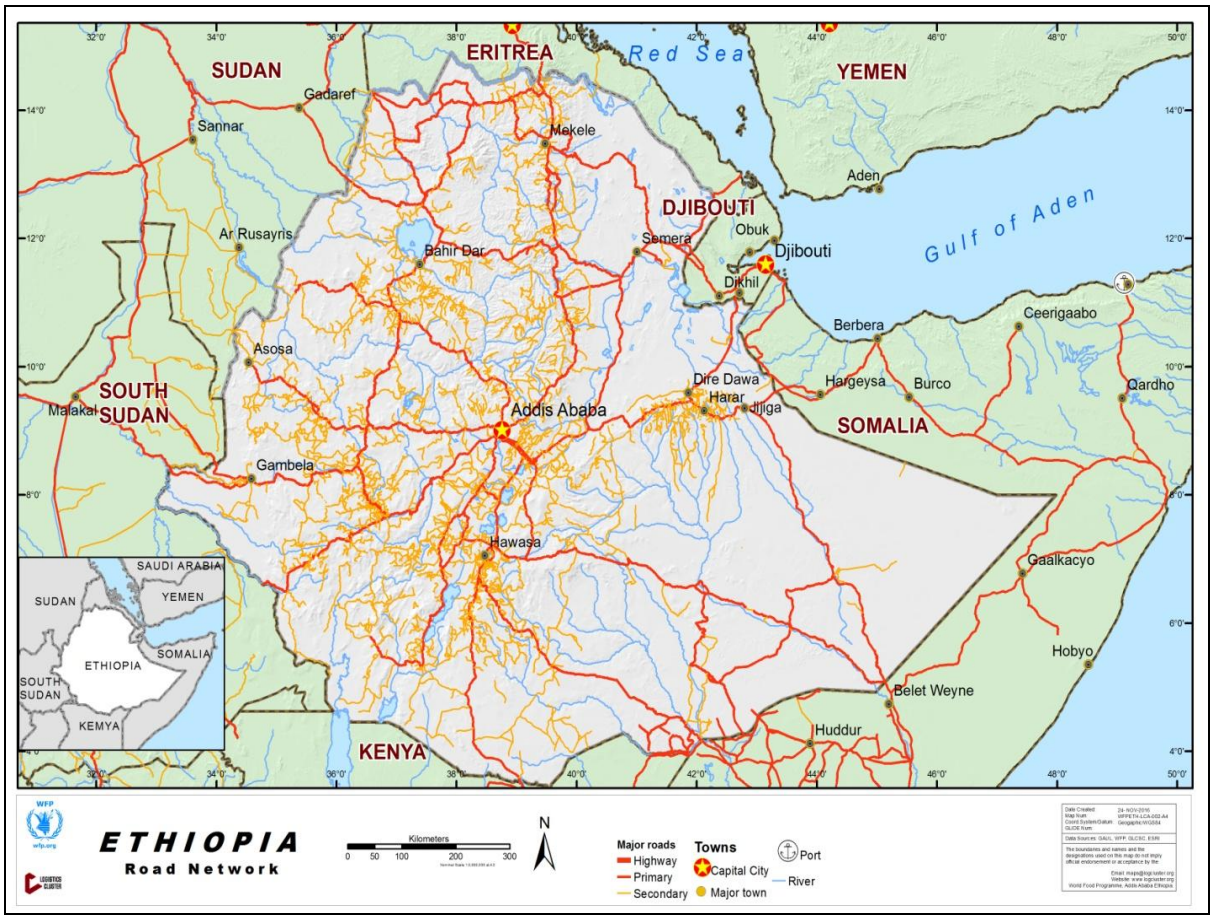

Figure 1.1: Ethiopian Road Network Map

Source: Logistic Clusture, 2016

Over nineteen years of RSDP, physical works consisting of rehabilitation and upgrading of trunk and link roads, construction of new link roads, rural roads & district roads and maintenance of federal and regional roads have been carriedout by Ethiopian Roads Authority (ERA), Regional Roads Authorities(RRAs) and WoredaRoad offices (WRO) and the community and municipalities. Series of policy and institutional reforms have been implemented in the sector, which have enhanced implementation capacity of roadprojects and effectiveness of Road Asset Management.

Moreover during these periods, the rural roads were considered through a Sub-Program under the RSDP;the Ethiopian Rural Travel and Transport Program (ERTTP), with specific emphasis on the rural sector, explored methods, technologies and approaches for new road construction and improvement at community and village level. Over the nineteen years of the RSDP, physical works were undertaken on a total of128,470km ofroadsexcludingroutine maintenance work and community roads. From the total physical work,38.4% of the total RSDP expenditure was on rehabilitation and upgrading roads, 29.6% was on construction of link roads, 4.5% on maintenance of Federal roads, 12.1% on Regional road and 12.9% on Woreda roads and 2.5% was on institutional support projects and other activities at the federal level.Figure 1.2 below shows the RSDP expenditure by category and implementers.

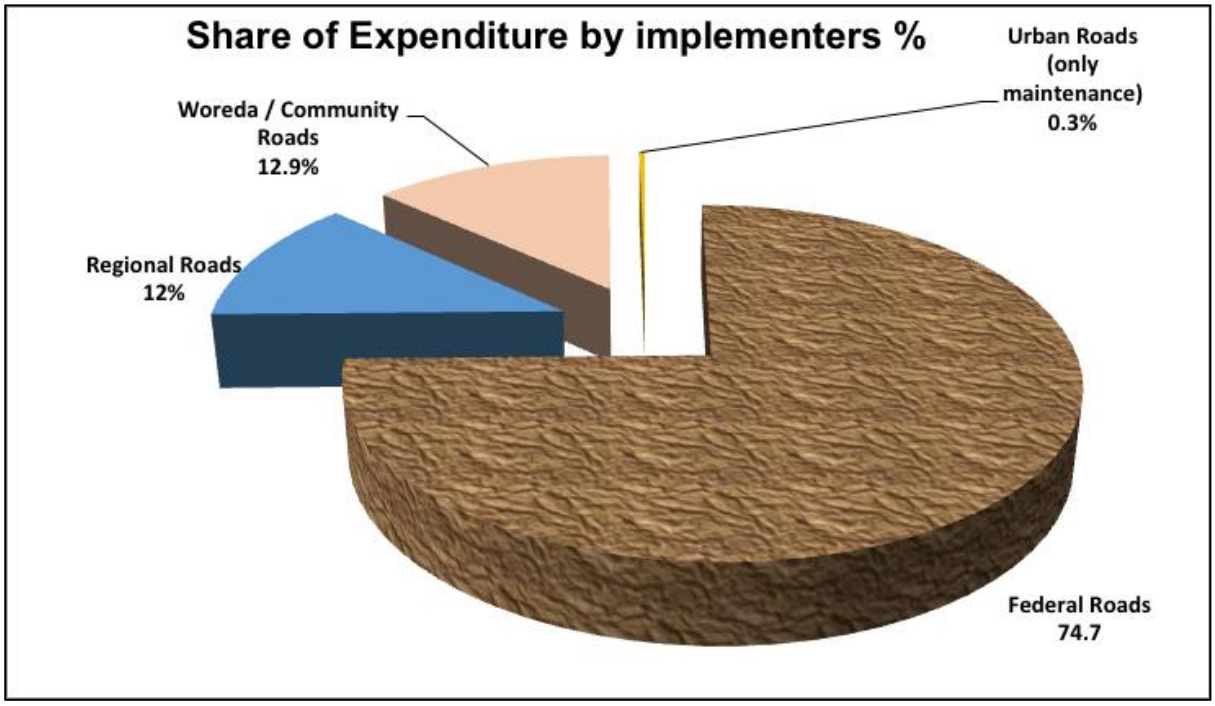

Figure 1.2: Share of Expenditure by Implementers.

Source: ERA RSDP 19 years performance report, 2016

Selection of Projects that have been implemented under the RSDP over the past 19 years had passed through different stages of preparation. The early stages of project selection and preliminary prioritization were based on a multi-criteria approach, MCA. After preliminary selection, using the MCA approach, the project preparation

moved to feasibility studies when a detailed economic and environmental analysis was carried out.

With this research the selection and prioritization practice that is implementing in the federal and regional/rural roads authorities will be evaluated, and the challenges and gaps of current practice will be assessed and identified.

1.2 Background of the Research

Given unprecedented levels of urbanization and motorization in developing countries and deteriorating infrastructure in developed countries, countries around the world have been facing the enormous challenges of delivering sustainable forms of infrastructure with scarce resources. As stated by Ziara et al. (2002), in the developing world, the challenges in road infrastructure investment become even more daunting as manifested by the staggering size of infrastructure funding gap. Therefore, prioritizing projects based on transparent and evidence-based decision-making processes has emerged as one of the most promising ways to bridge such enormous funding gaps, especially for developing countries. Ziaraet al. (2002) further stated that project prioritization in the public sector is in general a very complex and delicate problem due to huge investments, limited budget, conflicts between relevant criteria, influences of the actual state of politics and government. On the other hand, effective prioritization of infrastructure projects is hindered by a series of constraints including institutionalized inefficiency, inadequate data obstructing decision-making, insufficient coordination among various stakeholders, lack of public consultation, lack of technical capacity for project evaluation and prioritization, and lack of consideration of possible alternatives in the infrastructure planning.

This research is therefore envisaged to identify and assess the methods used to prioritize road projects investment in Ethiopia and assess the challenges experienced and gaps related to prioritization methods. Moreover, international practices will be reviewed from available literatures and comparison will be made with the Ethiopian practice. Having considered the identified gaps and findings of comparison; improvements and/or intervention actions will be recommended so as to strengthen the decision-making process on prioritization of road projects in Ethiopia.

1.3 Problem Statement

According to ERA 2016 AADT data and RSDP 2016 report,some of the road projects with higher AADT are not given priority for investment and some of the roads are constructed with low standard. For instance, Bahirdar – Gondar Road has an average AADT of 1849.5 with poor riding condition; however this project is not selected yet for rehabilitation based on the data found in ERA GTP II (2017). Whereas, more than fourtrunk roads with lower AADT than Bahirdar – Gondar Road section are selected in ERA GTP II plan for upgrading.

In view of that, it is envisaged important to evaluate the road projects investment prioritization methods in Ethiopia and thus is the focus of this research.

1.4 Research Questions

This study will attempt to answer the following key questions:

- ✓ What methods or practices are used to prioritize road projects investment in Ethiopia?
- ✓ What are the challenges and gaps of the current road projects investment prioritization practice in Ethiopia?
- ✓ How should the Ethiopian road project decision-making process be strengthened to optimize the limited financial resources for the road infrastructure investment where they would achieve the greatest impact?

1.5 Objectives

1.5.1 General Objective

The general objective of this thesis is to evaluate road projectsinvestment prioritization methods in Ethiopia and recommend improvements and intervention actions to strengthen the project decision-making process.

1.5.2 Specific Objectives

The specific objectives are to:

- ✓ identify and assess the prevalent methods used to prioritize road projects investment in Ethiopia;

- ✓ assess the challenges and gaps of Ethiopian current road projects investment prioritization practice;
- ✓ review international practices in prioritizing road projects investment;
- ✓ make comparison between the Ethiopian and international road prioritization practices; and
- ✓ recommendimprovements and intervention actions to strengthen road project decision-making process in Ethiopia.

1.6 Significance of the Study

According to ERA AADT 2016 data and RSDP report 2016, the road projects selection and prioritization methods for investment is found questionable. This paper will therefore evaluate the road projects investment prioritization practices in Ethiopia and go further to recommend the intervention and/or improvement actions to strengthen the current practice.

1.7 Scope and limitation of the Study

The scope of the study covers road project prioritization criteria currently used for federal and regional/rural road projects investment in Ethiopia. The federal road projects criteria was assessed from the Ethiopian Road Authorities; and for Rural Road Projects, due to time and budget limitation only, Oromia Rural Roads Authority (which covers 9031km out of 28033km, that means 33% of the Ethiopian road network) was included in this study. Source ERA website, distribution of the Ethiopian Road Network in to Regions 2016.

In this thesis, there were limitations which were encountered throughout the preparation of this research. These include unavailability of adequate documented information such as; feasibility study of different road projects (from regional road authorities) and post-evaluation report for government financed road projects (from the Ethiopian Roads Authority) are some of the limitations.

1.8 Application Area

In Ethiopia the first comprehensive planning manual which was prepared and published by Ethiopian Roads Authority, ERA was launched in May 2006. (Becker

and Demissie 2006) According to the study done by Tamrat fikire, (2014), the manual contains guidelines for multi-criteria decision making but any experience done by the guideline could not get in the authority. Therefore, it is justifiable to evaluate the current practice in prioritizing road projects with a particular emphasis to road project selection and prioritization methods for investment.

At the end of this research it is expected to provide the gaps of Ethiopian road projects prioritization practice for the establishment of a comprehensive multi-criteria decision making model to prioritize road projects for investment. This helps to optimize the limited financial resources for the road infrastructure investment where they would achieve the greatest impact.

1.9 Research Organization

The research is organized into five chapters, which are summarized as follows;

i) Chapter One: introduces the research problem and the aim of the study followed by the objectives of the research in achieving the depicted aim.
ii) Chapter two: is a literature review from journals, books, internet searches and discussions with professionals.
iii) Chapter three: discusses the research methodology followed in order to achieve the objectives of the study.
iv) Chapter Four: the results of the data obtained from interview, document review, questionnaire survey, case study and review of international practice were presented and discussed accordingly.
v) Chapter Five: conclusions and recommendations were forwarded based on the major findings of the study and discussed how the research objectives align with the findings.

CHAPTER TWO
LITERATURE REVIEW

2.1Road Transport Infrastructure (RTI)

As stated by Howe (2001), providing a new or improving an existing rural road usually results in a number of immediate effects; for example: employment in the work of construction or improvement, lower transport costs, more traffic, or faster journey times. In due course, usually over a period of some years, the effects, if they endure, may produce more long-lasting and structural changes, or impacts. Thus, impacts are essentially mid- to long- term changes i.e. over a 3-10 year period. Moreover, road investment can have both *direct* and *indirect* influences on poverty alleviation. Indirect influences are not manifest from investment in roads per sector, but through the extent to which accompanying changes do or do not occur. Broadly these can be defined as changes in:

- employment;
- transport;
- agricultural production;
- non-road related employment;
- non-agricultural production;
- social patterns; and
- institutions.

Road infrastructure has been considered as one of the most expensive and extensive infrastructure assets of the built environment globally. (Shafiqul Alam, Arun Kumar and Les Dawes, 2013) This asset also significantly impacts the natural environment during different phases of life. According to Alam et al. (2013), the life-cycle of a road pavement can be divided into five phases and these are: materials, construction, use, maintenance and end-of-life. Besides, road projects involve considerable land use, energy input and resource consumption, which often results in substantial impacts on environment and community. On the other side, Lepert and Brillet (2009) argued that there are road characteristics; for example, road geometry, pavement

structure and surface conditions and traffic congestion during road works, which impact fuel consumption patterns and consequent emission levels.

Booth (2012) also stated that the transportation sector is one of the areas which greatly contribute to climate change. Of course the transportation of goods and people has increased in demand in recent years as it has become necessary for social and economic prosperity. However, the demand for transportation has resulted in high congestion, more frequent accidents, higher transportation costs, excessive energy usage and pollution.

Hence, the growing emphasis for sustainable development to meet the needs of future generations requires mitigation of the environmental impacts of road infrastructure during all phases of life; for example, construction, operation and end-of-life disposal (as required). The emergence of "Green roads" concept initiates the development of various sustainability assessment schemes or tools in different parts of the world (Alam et al, 2013).

According to CEM (2008a), sustainable development is defined as the ability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. Some researchers like Oswald (2010) however, argue that construction (in particular transportation systems) can never be sustainable based on its very nature. Though construction of transportation system is difficult by nature, the use of nonrenewable resources, noise, pollution and the use of land can be minimized. In this regard, Black, (2010) defined sustainable transportation system as "one which will allow the basic access needs of individuals to be met safely while ensuring the health of the ecosystem and equity between and within generations, affordable and offers a choice of transport modes, efficient and supports a vibrant economy while minimizing emissions and waste to a level which is easily absorbed by the environment".

2.2Transport Project Prioritization

To bridge the enormous funding gaps for infrastructure projects, prioritizing projects at a system level based on transparent and evidence-based decision making process

has emerged as one of the most promising ways to reduce the overall cost of infrastructure, ensure public accountability and avoid arbitrary decisions. A project prioritization process should be considered simply as a tool in decision-making. As it is generally employed as part of a broader project programming process, and is thus still subject to human bias and the politics that guide these decisions. Priorities that are subjectively established run the risk of personal engineering bias, lack of comprehensiveness, and political bias. Furthermore, the increasing number, magnitude and complexity of the programs will make the subjective analysis unmanageable (Mak, 1978).

Although project prioritization is touted as the answer to bias in project selection, its foundation is explicitly subjective. Hence, at least subjectivity should be openly expressed so that citizens will be aware of it and respond through the decision process, if they are dissatisfied.

The need for analyzing public projects stems from the fact that society has a limited amount of resources to accomplish any proposed infrastructure projects. If resources are used to fulfill one project, it means that the same resources will not be available for others (Gamper&Turcanu, 2007). Thus, it is crucial that the politicians or decision-makers are informed in the most comprehensive overview how much resource the different projects will employ and all other impacts carried by these projects to the society and environment. Therefore, evaluation methods are needed to help the politicians or decision-makers rank and choose the projects based on their costs, benefits and impacts to the best of the society's welfare (Haezendonck, 2007).

There are varying reasons for infrastructure planning and investments such as overstrained and congested existing systems; trying to sustain an acceptable level of service; national or regional development issues; promoting local and regional economic growth; or safety and environmental objectives. The question of what measures and analytical tools should be considered in order to evaluate and analyze public infrastructure investments; and which projects should be prioritized that are aligned with their goals and purposes are valid in public domain eyes, since the projects involve substantial amounts of financial resources and many different

stakeholders, as summarized from (Hayashi &Morisugi, 2000; Jones et al., 2014; Salling& Banister, 2009; Thomopoulos et al., 2009).

2.2.1 Project Evaluation, Assessment and Appraisal

Although used interchangeably in the literatures**,** the terms "project evaluation", "project assessment" and "project appraisal" should be differentiated (Haezendonck, 2007). The definitions of these terms in Berechman (2009, p. 2) are used for the purpose of this thesis. "Project evaluation" refers to the overall process in which different investment alternatives are "conceptualized, generated, assessed, ranked and finally chosen". This process involveseconomic and non-economic criteria. On the other hand, "project assessment" and "project appraisal" respectively refer to "the structured procedure by which the transport-economic worthiness of each planning alternative is determined." Thus, project assessment/appraisal is a part of the overall project evaluation. In the public transport field, project evaluation involves contribution to the net social welfare by having insights on the projects' costs and benefits.

In theory, the decision and evaluation of infrastructure investments are influenced by three components. According to Preston (1996), in order to determine investment priorities, some mixture of operational/technical, strategic/political and socio-economic studies have to be conducted. According to Preston (1996), the following are stated in respect of the above:

- **Operational analysis**, which addresses questions concerning technical effectiveness of the investment to find the technically most superior solution, but it does not "contribute to questions of whether an investment is intrinsically worthwhile."
- **Strategic/technological assessment**, determine the potential of long-term, entirely new and innovative technology investments on a political level.
- **The socio-economic evaluation** tries to measure impacts of the investment on society now and in the future; to evaluate and estimate the social worthiness/social welfare of the project; and to achieve an optimal allocation of scarce resources.

2.2.2 Characteristics of Project Prioritization Process

According to Turochy and Willis (2006), the main concern of any prioritization system is evaluating identified projects and ranks them in order of importance. The level of complexity of the project prioritization processes, though, varies greatly. The literature has described minimum conditions for consideration as an acceptable methodology. First and foremost, there is the issue of rationality. Turochy and Willis (2006) define a rational procedure as "one with clear steps and a sequence". This idea is critical as it distinguishes between a systematic methodology that can be consistently replicated versus one without a well-defined structure. A non-rational process is open to the bias of the evaluator.

Secondly, there is the discussion of defensibility. Turochy and Willis (2006) define a defensible procedure as one that is "open to scrutiny with respect to the data used in the process and which resultant scores or rankings assigned to projects evaluated are related to the attributes of the proposed improvements."

Litman (2003) conducted a comprehensive literature review on the use of performance criteria for sustainable transportation planning, which defines nine principles of selecting the most appropriate criteria: comprehensive, quality, comparable, understandable, accessible, transparent, cost-effective, net effects and functional.

On the other hand, Hine et al. (2003) select five major categories of criteria. Those categories consist of economic, engineering, environmental, social and risk/political categories. One of the categories covers the economic efficiency impacts of the proposed project, by monetizing the associated costs and benefits. Within the economic efficiency criteria, net present value (NPV) is defined as the difference between the present value of costs and benefits. Projects with positively higher NPV are regarded as more economically efficient. Internal rate of return (IRR) refers to the rate of investment that equalizes present values of benefits and costs of the project under evaluation. In most cases, IRR is always compared to the minimum attractive rate of return (MARR) to assess if the proposed project has sufficient value. Benefit-cost ratio (B-CR) is the ratio of present value of benefits to present value costs, which

is recommended for transportation evaluation with projects that have explicit values of benefits/costs.

Each prioritization system will be unique, although each will likely involve the following steps:

- selecting criteria with which to evaluate projects;
- creating performance measures to compute project compliance to those criteria;
- combining scores for each performance measure in some way; and
- finally ranking the projects in order of importance.

The criteria selected will but tend to associate to the planning factors: safety, traffic congestion, and environmental impacts, among others (Turochy and Willis, 2006).

According to BekeleNegussie (2004), main road project in Ethiopia starts with identification of potential projects, which will best contribute to government objectives and development of economic sectors (such as: agriculture, mining, tourism, industry). The basis for identification might be as a result of Economic Development Potential of the specific area, developing Import-Export Corridor, Improve accessibility, increased traffic level, improving road condition.

The World Bank (2001),stated that the role of low-volume transport infrastructure interventions including the social importance is for ensuring basic access to resources and opportunities. Where benefits cannot be measured in monetary terms, it is recommended to use the Cost Effectiveness Approach (CEA), which compares the cost of interventions with their intended impact (Cost/population served). To overcome the problem of open-ended threshold associated with the CEA method, an extended Cost- Benefit Analysis is used on a sample of projects. The extended CBA approach includes better assessment of RTI project such as non-motorized transport (NMT) operating costs and modal change savings and valuation of social benefits from improved access to schools and health centers.

i. The Basic Access Approach

J. Lebo D. & Schelling (World Bank, 2001) define a basic access intervention as "the least-cost (in terms of total life-cycle cost) intervention for ensuring reliable, all-

season passability for the locally prevailing means of transport". Consistent with a basic needs focus, the basic access approach gives priority to the provision of reliable, all-season access, to as many villages as possible, over the upgrading of individual links to higher than basic access standard.

On the other hand, local communities are the main stakeholders and users of RTI. In recognition of this, there is now wide acceptance that their participation in the preparation and implementation of investment programs enhances local ownership and commitment, and fosters better accountability, management and sustainability.

ii. A Participatory Planning Approach

Due to the increasingly decentralized framework for the provision of local services, and in order to build ownership and mobilize local resources, the planning (and monitoring and evaluation) process for RTI must be participatory (J. Lebo & D. Schelling, World Bank 2001). Whereas simultaneously "bottom-up" and "top-down" iterative approaches are required, the starting point for the process consists of consultations at the local government and community level.

A key tool for the participatory planning process is a local government or community transport plan. Local engineers or consultants, in consultation with communities, should conduct a low-cost inventory and condition survey of the local transport network, including roads, tracks, paths and footbridges, with a focus on existing obstacles. On the basis of the information generated, and additional economic, social and demographic information, a map should be produced. Based on such information, stakeholders can co-operatively decide upon desired improvements in the RTI network, taking into account objectives and available resources. It has been argued that participation can replace the economic selection process. This might be the case if investments are entirely locally financed, but even then the "wish list" will typically be more sizeable than available resources and a rational process (using economic criteria) should be used to help prioritize alternative investments.

2.3Selection and Priority Setting Methods

According to J. Lebo and D. Schelling, World Bank (2001), selection and priority-setting methods for basic access RTI interventions consist of two broad types of

methodologies which are usually applied in succession: screening and ranking. Details of those methods are summarized as follows according to the World Bank (WB) study.

2.3.1 Screening Method

Screeningdecreases the number of investment alternatives given budgetary constraints, which may involve: targeting disadvantaged areas or communities based on poverty indexes, or eliminating investments into low-priority sections of the network selected based on agreed criteria.

i. Targeting Poor and Disadvantaged Communities

One of the purposes of screening is to target investments to disadvantaged regions, local governments and communities. Screening approaches were developed initially for targeting isolated or economically deprived communities and regions. They have since been adapted for the selection of districts, communities, and municipalities on the basis of poverty criteria-measuring economic standing and potential, as well as social development (such as literacy and health statistics). In China, for example, poverty-based pre-screening was used to identify "priority counties." A second- and third-stage screening process was then used to identify specific road sections and corresponding design standards. (Hajj and Pendakur, 2001).

ii. Eliminating low-priority links of the network

Another use of screening is to eliminate low priority links from consideration for investments. For example, in the case of the Andhra Pradesh district (Hajj and Pendakur, 2001), transport master planning process in India, it was decided that for each village only one link, normally the shortest one, would be upgraded to basic access standard. This reduced the road network that was considered for interventions from about 5,000 km to 3,000 km per district. There are many other examples of elimination by screening. In the province of Saskatchewan in Canada, wheat farms are based on square mile lots. Along the perimeter of the lot, there is normally a public access road from which a penetration road leads to the farmhouse.

When selecting which of these access roads should be graveled (which means the provision of costly "crusher-run" material because the in-situ soils are mainly clays) it

has been decided that, per farm, only one access road to the main road system (and normally the shortest one) is being graveled (and therefore becomes an all-season road) while the others remain seasonal earth roads. (This represents the provision of "basic access" under budget constraints in a developed country).

2.3.2 Ranking Methods

After screening methods have been applied to a given set of investment choices, resources are still unlikely to be sufficient to finance the balance of the remaining desirable interventions, and hence a ranking or prioritization exercise is required. The following three main ranking methods for RTI are discussed in the following paragraphs:(i) Multi-criteria analysis, (ii) cost-effectiveness analysis, and (iii) cost-benefit analysis.

i. Multi-Criteria Analysis

Multi-criteria analysis (MCA) is the commonly used method to rank RTI investments. MCAis developed on the basis of the criticism of CBA. (Thomopoulos et al., 2009). It is "capable of eliciting the trade-offs between objectives (e.g. transportation efficiency, improved equity, and reduced environmental externalities) in ways that enable decision makers to make rational and systematic choices regarding the preferred project" (Berechman, 2009).

According to Berechman and Thomopoulos et al., (2009), this method has evolved as a multi-objective decision making approach for situations in which a single-criterion approach is incapable of providing the required assessment framework due to usually conflicting criteria. It needs to be pointed out clearly, that "participation of the decision-makers in the process is a central part of the approach." Similarly, Lebo and Schelling, World Bank (2001), stated that MCA aims to "to allow each decision-making environment to engender its own set of criteria, measure and score them, and then generate a system of relative weights specific to the given context". Criteria such as traffic level, proximity to health and educational facilities and agricultural assets receive weights (points) relative to their perceived importance. In most examples, indicators used under MCA implicitly reflect economic and subjective evaluations. If the weights and points are decided upon and allocated in a participatory way, MCA has the potential to be a participatory planning method based on implicit socio-

economic valuation. However, it tends to be applied by consultants or planners in isolation without consultation with the concerned users and stakeholders. The outcome of the MCA methodology is often, unfortunately, non-transparent, especially if too many factors are considered and a complicated formula applied. Therefore, if adopted, this method has to be used with great care and kept simple, transparent, and participatory.

a. Main phases of MCA

In this section, the major phases that are normally followed when conducting a MCA are explained as summarized by Berechman, (2009), Gamper&Turcanu, (2007), Stevens, (2004);Thomopoulos et al., (2009) and Tsamboulas, (2007). They are accounted for the most important stages and parts with the relevance to this thesis. The explanations of the steps are provided as follows:

- Identification of criteria and preferences

In this phase, from various alternatives, where each one is contrasted to a predefined set of objectives (by the decision-maker), preferences are established; and measurable criteria indicators are set up to test if the objectives are met. According to Berechman (2009), all transportation and non-transportation impact categories need to be systematically scored, making use of measurement scales (e.g. cardinal, ordinal, interval or ratio).

The ordinal measurement scale is used when no cardinal (explicit numbers) score can be given or are too difficult to derive. By using an ordinal method, projects are ranked "on the basis of selected criteria without assigning quantitative values to them" (Berechman, 2009). This requires that objectives need to be set for all the chosen evaluation classes. In the end, a comparison of the ordinal ranks, gives a clue about the most desirable alternative.

- Criteria evaluation and weights generation;

In this phase, the significance of each indicator is defined in a form of a weight for each impact category by the decision-makers. The weight is reflecting the relative importance of the criteria for decision-making. It is crucial to find the appropriate weights for each category (Berechman, 2009) because (1) if the final ranking of the

alternatives is invariant according to the weights, the MCA as a decision-making tool is useless; and (2) if the ranking is sensitive to the weights chosen, the weights needs to be properly reflected. Tsamboulas, (2007) recommendsto set a criteria categories for which weights can be easily established using data that is available, otherwise, make use of quality attributes, such as expert opinions and judgments.

- Prioritization and ranking;

In this phase, a final score is derived for each criterion, summed up to a total score for the alternative. The score is normally between 0 and 1 respectively 0% to 100% (Thomopoulos et al., 2009). The weighted, total score aims to "assist decision makers to realize the time-order of implementation in the desired time horizon" (Tsamboulas, 2007), which refers to short-, mid- or long-term respectively not at all.

- Sensitivity analysis

Sensitivity analysis within MCA it is common to do a sensitivity and/ or robustness analysis of the criteria / weights chosen. (Berechman, 2009; Gamper&Turcanu, 2007). The explicit attempt of the MCA method is "to eliminate subjectivity in the generation of decision weights and thereby make the overall" evaluation-selection process consistent and transparent. (Berechman, 2009)

Berechman, (2009); Gamper&Turcanu, (2007) summarized the strength and weakness of MCA as shown in Table 2.1 below:

Table 2.1: Strengths and Weaknesses of Multi-Criteria Analysis

No.	Strengths of MCA	Weaknesses of MCA
1	Openness to divergent values & opinions	Subjectivity of generated weights
2	Supports a broad stakeholder participation	Technical complexity (for instance the choice of parameters)
3	Preferences revealed in a more direct & practical way	Potentially time-consuming process
4	Capability to tackle qualitative & intangible impacts	Experts' reluctance to share their knowledge/power
5	Helps legitimize decision-makers' behavior	Information bias from certain stakeholder groups to strengthen their power

As the table above shows, one of MCA's main criticisms lies within the involvement of the stakeholders in the process of making up preferences and weights and thus remains its major challenge. "Paradoxically, the major weakness of the (MCA) method arises from its major strength: the value judgments by the decision makers."(Thomopoulos et al., 2009). It means that since the weights and criteria are chosen by the decision makers themselves, these preferences "do not necessarily reflect the preferences of the people as they are expressed when making choices under the restriction of limited resources" (Saitua, 2007). Since various stakeholders will most likely have different priorities or objectives, MCA in that case could not help to find a single best solution. One way to avoid these potential negative effects for society is to set up rules and regulations for the decision-makers' behaviors in a manner that secures the preferences of the society (Gamper&Turcanu, 2007).

Bots and Lootsma (2000) raise two valid questions on the applicability of MCA in decision-making. Firstly, without any contextual information, are the weights meaningful, if scoring alternatives on criteria and assigning weights to these criteria are performed by two different people (stakeholders)? The threat is that in practice the criteria have often a vague nature and it follows that "inconsistent weights are often produced, which may lead to unreliable decision outcomes." (Yeh et al., 1999). Secondly, again, without any contextual information, can judgmental data generated by experts be properly interpreted by the decision-makers? (Bots &Lootsma, 2000). The point is "the first problem can be tamed, while the second remains elusive."(Bots &Lootsma, 2000).

ii. Cost-Effectiveness Analysis

As stated by Dominique Van de Walle (1999), a subset of the MCA is the cost-effectiveness analysis (CEA). CEA compares the cost of interventions with their intended impacts. CEA is widely used to appraise investments in the social sector, however, has rarely been used in the transport sector. This has largely been due to the belief that the impacts of transport interventions are mainly economic in nature and should be measured. With the increased focus on the poverty and social impacts of transport investments, and their justification on these broader grounds, CEA has recently become more prominent.

According to Lebo and Schelling, World Bank (2001), mostly, there will not have well-established criteria for determining "opportunity cost" thresholds when ranking on the basis of cost-effectiveness. To overcome the problem of open-ended thresholds associated with the CEA method, it is desirable to complement the CEA method with a sample study based on cost-benefit analysis for one or two roads in the project area. If this sample study can establish that a per-capital threshold of investment meets the prescribed economic rate of return for the sample, then all links above the threshold are likely to be viable. Such an approach has been shown to provide a good economic basis for applying the CEA method to a broad RTI investment program, especially where socio-economic characteristics do not vary greatly.

Browne & Ryan (2011) stated that CBA is the most widely used tool for evaluating policy programs and capital expenditure. It involves estimating, where possible, the full direct and indirect private; and social costs and benefits associated with a policy action or potential project. It involves monetizing all costs and benefits related to a project or policy strategy and examining the ratio of total benefits with respect to total costs, i.e. the benefit–cost ratio (BCR).

According to Nickel et al., (2009), CBA is generally used in ex-ante project appraisal in order to quantify social benefits and project costs and estimate which project alternatives yield the greatest net welfare benefits. In transport projects appraisal process, typical criteria such as reduction in emissions, delays, crash costs or noise imposed by the policymaking bodies, have to be evaluated. The policymaking bodies designed CBA guidelines that analysts use as references.

iii. Cost-Benefit Analysis

As stated by Lebo and Gannon (1999), the most common approach for the economic evaluation of road investments is CBA. CBA is a comprehensive accounting of all the real costs and benefits associated with a (road) project. This includes users and non-users, as well as the road agency. Where the impact on non-users is negligible, a CBA of road alternatives centers around the trade-offs between total life-cycle costs of infrastructure (capital and maintenance) and user costs and benefits (operating cost of the primarily vehicle and time savings). The outcome of CBA permits ranking of alternative interventions on a particular link based on the net present value (NPV).

Where a number of different but independent links are being considered (and there is a fixed capital budget) ranking can be based on the net present value per financial investment outlay ratio (NPV/INV), or net present value per kilometer (NPV/KM), if road infrastructure costs (capital and maintenance) are the same for all links. The benefit from cost savings for transport users can be considered an increase in "consumer surplus", if such savings accrue to the users as reduction in transport costs or charges. Alternatively, if transport cost reductions lower producers' input and output costs, and result in higher net income, then the benefits can be considered as an increase in "producers' surplus".

a. Producer Surplus Methods

According to Carnemark, (1976) and Beenhakker (1983), this method requires assumptions concerning the impact of transport investments on local agricultural productivity and output which are difficult to assess, particularly in a situation where interventions are expected to open up new areas and adequate production data may be difficult to compile. To the extent that RTI investments are increasingly focused on existing networks and often put more emphasis on social rather than economic objectives, the application and relevance of the producer surplus method has decreased in recent years.

b. Consumer Surplus Methods

As stated by Archondo-Callao (1999), consumer surplus methods are well established and applied in road investment models, such as the Highway Development and Management Model, Version 4 (HDM-IV). The methods are reliable to apply to higher-volume roads (>200 VPD). However, its application to low-volume roads encounter problems related to the small magnitude of user benefits and the stronger influence of the environment rather than traffic on infrastructure deterioration. With traffic levels between 50 and 200 VPD, and particularly with regard to unpaved roads, a modified and customized approach can be taken, as is done in the recently developed Roads Economic Decision Model (RED). This method attempts to take into account uncertainty related to the input assumptions and an expanded treatment of user benefits.

For traffic levels below 50 VPD, as is the case on the majority of RTI, the consumer surplus approach is usually not recommended because the main benefits from such projects are not from savings in motor vehicle operating costs, but relate to the provision of access itself. For various reasons, the benefits of access are difficult to quantify. Also, traffic on such very low volume RTI typically consists of a majority of non-motorized vehicles (where part of the costs are human energy needed to pull or push the vehicles, which cannot be easily priced), animal transport such as haulage by mules, walking and head loading (porterage). Therefore, it is recommended using the traditional method of CBA.

iv. Integration of Cost-Benefit and Multi-Criteria Analysis

Thomopoulos et al., (2009), mentioned two main areas that MCA differs from CBA:

- MCA has no limits in the forms of criteria in the sense of that it allows also for "intangible" elements like for instance equity considerations; and
- MCA does not require the use of prices; MCA makes use of weights and scores (note that prices might beused though to derive these overall scores).

More recently, some authors have claimed the integration of the Multi-criteria and Cost-benefit methodologies to fully consider sustainability. Particularly, "MCDA is a good tool for the indirect actions where soft and indirect effects prevail; while CBA for the direct ones; and where monetizable costs and benefits prevail" (Beria, Maltese, &Mariotti, 2011). Barfod, Salling, &Leleur (2011) depict the above description by developing a composite decision support model based on combining cost-benefit analysis (CBA) with multi- criteria decision analysis (MCDA). Also, Gühnemann et al. (2012) developed a novel approach of combining both appraisal techniques within a road infrastructure development program by incorporating CBA results into an MCA framework.

v. Appropriatemethod of prioritization

According to J. Lebo and D. Schelling, World Bank (2001), the role of low-volume transport infrastructure interventions including the social importance of ensuring basic access to resources and opportunities. Where benefits cannot be measured in monetary terms, it is recommended to use the Cost Effectiveness Approach (CEA) which compares the cost of interventions with their intended impact (Cost/population

served). To overcome the problem of open-ended thresholds associated with the CEA method, it is desirable to complement the CEA method with a sample study based on cost-benefit analysis for one or two roads in the project area. If this sample study can establish that a per-capita threshold of investment meets the prescribed economic rate of return for the sample link, then all links above the threshold are likely to be viable.

Such an approach has been shown to provide a good economic basis for applying the CEA method to a broad RTI investment program, especially where socio-economic characteristics do not vary greatly. Otherwise, an extended Cost- Benefit Analysis is used on a sample of projects. The extended CBA approach includes better assessment of RTI project such as NMT operating costs and modal change savings and valuation of social benefits from improved access to schools and health centers.

According to Browne & Ryan, (2011), Cost-Benefit Analysis (CBA) is the most widely used tool for evaluating policy programs and capital expenditure. It involves estimating, where possible, the full direct and indirect private; and social costs and benefits associated with a policy action or potential project. It involves monetizing all costs and benefits related to a project or policy strategy and examining the ratio of total benefits with respect to total costs, i.e. the benefit–cost ratio (BCR).

According to the research made bySahadevet al., (2009) in Nepal, for rural road construction in developing countries the following criterias were considered to rank the projects. On the other hand, developing countries are facing resource scarcity for maintenance, which should be important sub criteria in ranking the rural road projects.

- Population Served Per km
- Access to Educational Facilities and other facilities
- Community Priority as a road
- Encroachment in historical/Cultural Areas
- Possibility of landslide/erosion or flooding
- Impacts on Natural System

As learnt from the above sections, for evaluation criteria for ranking road projects in the developing countries these different criteria of sustainability with participatory approach will help to sensitize the participants about the importance and preparedness for positive and negative impacts of the projects. Besides, some additional criteria such as traffic volume, access to tourism, hydropower project area, agricultural and livestock pocket area, access to adjacent linkages, future settlement developments, spatial distribution etc. shall be better to be added in the local evaluation criteria.

2.3.3 Criteria Weighting Methods

As stated by Carol Gosenheimer (2012), many departments struggle to balance a growing list of new and pending projects while the need for core services continues, often with less funding. Deciding how to prioritize and separate the high priority projects from lower priority projects can be daunting. Since emotions often run high when making these kinds of decisions, a structured and objective approach can be helpful in achieving consensus and balancing the needs of the department and its customers and stakeholders. Using a prioritization matrix is a proven technique for making tough decisions in an objective way. A prioritization matrix is a simple tool that provides a way to sort a diverse set of items into an order of importance. It also identifies their relative importance by deriving a numerical value for the priority of each item.

According to Carol Gosenheimer, (2012), creating and using a prioritization matrix involves five simple steps:

- Determine the criteria and rating scale;
- Establish criteria weight;
- Create the matrix;
- Work in teams to score projects; and
- Discuss results and prioritize your list.

Each department determines its own unique criteria and weighs those criteria based on values, strategic direction, organizational goals, available resources, and so on. Projects are then scored and prioritized based on those criteria.

2.4Challenges in Prioritizing Projects

According to Ziara et al. (2002), effective prioritization of infrastructure projects are hindered by a series of constraints, including inefficiency of institutional structures, lack of data to support decision-making, inadequate coordination among various stakeholders, lack of public consultation, lack of technical capacity for project programming, and lack of consideration of possible alternatives in the infrastructure planning.

According to Liu and Smith (2006); Karvetski et al. (2009) and Jones et al. (2013), there are five major challenges of setting priorities for infrastructure development in developing countries and they are lack of;

- Systemic approach to deal with the competing objectives among social, economic and environmental issues;
- Integration of preferences, attitudes and organizational values of involved stakeholders;
- Public participation, consultation and monitoring in the transport planning process;
- Consistency of project prioritization strategies that lead to ad-hoc case-by-case decision-making process; and
- Risk management to ensure the potential costs and benefits are equitably allocated.

As stated by Haezendonck (2007), transport project evaluation has become a very complex task due to ―”incomplete information on, for example, the environmental impact of certain investments, uncertainty of exact traffic evolutions and pay-offs, an increasing set of regulations and regulatory bodies and controversy on the methodology to be used for the valuation of environmental and social impacts.".As Hollick (1986) mentioned, detailed environmental information is not always available to decision makers because of failure to apply environmental impact assessment (EIA) to all relevant decisions. Furthermore, Hollick (1986) mentioned that the success of EIA depends on adequate monitoring, reassessment, and enforcement over the life of the project. An EIA states what needs to be done but no checks on how a project actually followed through when comes to construction.A study conducted by

Jørgensen, Bocq, Nazarkina, &Hauschild (2007) also found that the perception of social impacts is very variable across the social life cycle assessment (SLCA) approaches.

On the other hand, Hill (1968) claims that "benefits and costs have meaning only in relation to a well-defined objective" and the development of these objectives will be subject to the values and principles of decision-makers and their constituents. As Hill (1968) further stated, there is another drawback in project prioritization, which is the difficulty in comparing projects with different purposes.

With regard to the impact of poor implementation practice on the success of planning, Botswana Road Department, Guideline No. 05 (2001) stated that, impacts related to construction, operation and maintenance should be clearly defined such that all parties to the contract are aware of their respective responsibilities. Mitigating measures should be incorporated in the tender and in contract documents for implementation during the construction phase. The type of each mitigating measure and when it is to be implemented during construction should be stated for both adverse and beneficial impacts.

2.5Relevance to this Research

Regarding this research, two case studies that show development of criteria weighing were reviewed and are summarized hereunder.

2.5.1 Multi-Criteria Decision Modeling for Infrastructure Development: A case of the Ethiopian Highway Rehabilitation Projects.

The main objective of this research is to propose a full-fledged, comprehensive, and semi-automated model that can prioritize all highways of Ethiopia for rehabilitation. There are two specific objectives under this major aim. These are: to design a multi-criteria decision model for national road project prioritization and to implement the proposed model with real data of Ethiopia and see the results.

This study used the procedure of Analytic Hierarchy Process (AHP). AHP is a decision making tool that was created by Saaty (1980) and Takano (2007). AHP allows a set of complex issues that have an impact on an overall objective to be

compared with the importance of each issue relative to its impact on the solution of the problem. In this regard, Álvarez et al. (2013), used a matrix of elements (criteria or alternatives) to make a pair-wise analysis and end up with an "Eigen vector" which is the relative weight of the elements under consideration. The total sum of the Eigen vector is 1.

In order to set the weights of the criteria and indicators, six knowledgeable Ethiopian experts working in the transport sector were given a detailed AHP questionnaire during data collection. (Tamirat Fikre, 2014) The criteria were: social benefits, economic benefits, administrative or political importance and capital costs. The analysis of the data gave the Eigen vector and transformed the indicator data for each alternative. This part involves transformation of data of each indicator into a common format by using relevant mathematical function. The real data was converted into utility value (UV) which ranges from 0 to 1 inclusive.

In conclusion, the model is composed of 4 criteria, 22 indicators and 68 highway segments which are selected from the entire country. All the remaining highways are of low hierarchy as compared to the 68. The four criteria are social benefits, economic benefits, administrative or political importance and capital cost. Except the missing of environmental aspects, these criteria are believed to represent the concept of sustainable development. The ultimate result of the model was the ranked list of highways; top 20 and top 10 ranked highways are identified.

2.5.2 Multi-criteria Evaluation for Ranking Rural Road Projects: A Case study in Nepal

In this study, AHP was used to determine the weightages of evaluation criteria for ranking rural road projects. The study describes the evaluation criteria involving three aspects of sustainability and finding their importance for ranking rural road projects. The evaluation criteria were derived from a thorough literature review and individual importance was determined via a Google survey among different experts, who have worked on rural roads in Nepal and other 22 countries. This survey used AHP. Thirteen sub-criteria and three criteria were considered in the question on the survey and almost all of the respondents replied that these criteria and sub-criteria were necessary for the ranking of rural road projects from the point of sustainability. In

order to understand better summary of weightages of the evaluation criteria is discussed under sub-sections in respect of: Measurement of criteria, and Weightage of criteria.

i. Measurement of criteria

From the literature review and collection of experts' opinions, three groups of criteria (economic costs, social aspects and environmental aspects) are determined for ranking sustainable rural road projects. An absolute and the relative measurement are used for the determination of the score of the criteria. In an absolute measurement, the score of each criterion is derived in 100-point scale. Local institutions shall define the methodology of the determination of score of the different alternative of rural transportation projects, which depends upon local conditions influence. If the authentic body does not define such methodology the final decision in 100-score will be converted as follows.

Firstly, the performance indicator is measured in different appropriate units. The probability distribution of all data is assumed approximately normal. The measurement is normalized with the calculation of Z-score. The Z score is converted into percentile score using conventional statistical formula or Z table.

In relative measurement, the pair wise comparison matrix is developed for each alternative in the scale of 1 to 9. The relative score of each criterion is determined by eigenvector found with normalized matrix using AHP. Parameters of the various evaluation criteria are described below.

- **Economic criteria** have been defined by the two groups of sub-criteria as financial costs and social costs. Financial costs can be described by the three sub-criteria: construction and maintenance cost of the road project and vehicle operation cost. The social costs depend upon location (urban or suburban), road geometry (gradients, width, horizontal and vertical curves etc.). Three types of social costs: travel time costs, accident costs and pollution costs are considered in the evaluation of rural road projects.

- **Social factor** generally refers to the social benefits from the transport projects. It has been described by the four sub-criteria in this study viz.

population served per km, access to educational services, access to health, administrative and market services and road as a community priority.

- **The environmental aspect** is an important factor for sustainability of the road projects. Environmental aspects are further sub classified into the three sub-class viz. encroachment on historical/cultural and precious ecology, possibility of landslide or flooding, and impacts on natural system such as forest, hydrology and others.

ii. Weightage of criteria

The above mentioned criteria are synthesized in two levels using AHP. At the first level, three major criteria viz. economic, social and environmental aspects are taken into consideration. At the second level analysis, all thirteen sub-criteria representing the first level criteria are taken into consideration. The criteria and sub-criteria at each level are compared pairwise with respect to each other in order to determine the relative weights of all criteria.

2.6 International road projects selection and prioritization practice

Four countries road projects prioritization practices were reviewed which are relevant to this study, and summarized hereunder.

Applying the Basic Access Approach: Vietnam's Second Rural Road Project

Vietnam's Ministry of Transport in 2012 developed a program to improve the national 'community access road', CAR network. The project aimed to provide "basic road access" to all communities. The prioritization process was largely based on the approach of community participation in prioritizing road network. The project team together with sub-county officials then arranged discussion session with the community to identify CAR network.

Following initial discussions to find out about the CAR network and its maintenance, each sub-county was assisted to draw a map of the sub-county and its main roads, including national, district and 'main' community access roads. Then, at a workshop with about 60 local leaders and representatives, including local road workers, all the sub-county's roads were listed with their lengths. The order of importance of the roads was determined by the criteria summing the number of times each criteria

chosen in ranking their roads. The results were then combined into a list of the top 15 roads. There was consensus on the outcome and local leaders welcomed the exercise as effective and transparent, producing a list of their priority roads that were well-justified. With every village represented, details of the outcome and means of reaching it could be conveyed back to the villages.

In summary, the process used was for a broad group of local community representatives to identify their main road network and use their own collectively defined criteria to determine the most important roads in order of importance. Their criteria included social and economic indicators. This followed with agreement on the interventions and the signing of a memorandum of understanding.

Source: A method for appraisal of low volume roads in Vietnam, M.BENMAAMAR, October 2012

The case of the UNCDF/UNDP District and Feeder Roads Project (DFRP) Tanzania

The seven-year project covers the six districts in Mwanza Region with the objective of promoting economic development and alleviating poverty by improving rural communities' access to economic and social facilities. During the project's 'Stakeholder's Workshop' in 2009, a key concern of the DFRP was its participative approach and the selection of the roads for rehabilitation was identified as a main area where stakeholders would have a chance to participate in the decision-making process.

The road selection workshops brought together stakeholders from the District Council (District Management Team members), technical staff from the District Engineer's Office and representatives from the communities. The criteria for ranking were pre-determined and based on economic, social and technical aspects. The criteria and scoring was meant to be easily understandable so that the exercise was relatively simple and participants were able to clearly brief their communities on the process when they returned.

Presentations at the start of the workshop included that by the District Engineer (DE) on the status of the district road network. Following other presentations on the criteria and intervention strategy options, the participants split into division-based groups and endorsed/corrected the division's list of essential roads before assessing each of them on the basis of the pre-defined criteria and computing the scores. Workshop recommendations were then submitted to the District Full Council for endorsement and approval. The selection of roads for rehabilitation works in each district was then taken from this list following order of priority and ranking. In all cases, the District leadership expressed satisfaction with the process and outcome.

Source: Appraisal report roads rehabilitation/ upgrading project, united republic of Tanzania (August, 2009)

Criteria and Weighting for Prioritization of Rural Road Network in Indonesia,

A decision making process that starts with a list of the priority public sector development projects in the road sector and ends with a list of potential road projects. These projects have been prioritized through the planning processes within Government.

For the overall selection Criteria, Director of General Highway identified 7 different elements that would serve as prioritization criteria with the aim of achieving the following goals.

Safety: This includes eliminating sight distance problems at intersections, correction of hazardous curves, projects that improve pedestrian safety and projects that address areas with high accident rates. Hence, project does not effectively address safety issues in the project area would score zero points.

Social Impact: This includes minimizing negative impact in settlement pattern (refers to the number of dwellings that would have to be demolished due to the road footprint and the consequent resettlement of the inhabitants), and land use of the area or province character.

Environmental Impact: Project has no expected environmental impacts would get highest score, project environmental impacts can be mitigated at reasonable cost would get medium score, and Project is expected to have significant environmental impacts would get zero score.

Support economic vitality of the community: Promote and strengthen the economic vitality of the community. Project does not have positive community benefits would get zero score.

Sustainability: Maximize the effectiveness and performance of the roads through innovative strategies and techniques.

The selection criteria are presented herein below, along with their recommended weighting.

Long-range improvement goals

Weight

1. Maintain the existing roads to maximize the significance of the road network 10.3
2. Improve the efficiency, performance and connectivity of the roads 18.0
3. Promote consistency between land use and road network 10.1
4. Provide a safe and secure roads 17.8
5. Support economic vitality of the community 14.5
6. Protect and enhance social and environmental sustainability, and preserve natural resources 17.7
7. Maximize cost effectiveness 11.6

Source: A new planning process for prioritizing rural road projects for the region's road network plan and comprehensive economic development strategy, Indonesia, January 2010

The case of Pakistan Road Projects Prioritization Criteria

Pakistan's current prioritization process adopted by the Council back in 2016 had several factors that were considered in the enhanced prioritization process. These factors included:

Factor #1: Safety: High Accident Locations - Severity of Existing Conditions
Project Scope - Extent or Comprehensiveness of Project on Safety

Factor #2: Pedestrian: Access/Connections - Types of Land Uses Interconnected
Effective Length - Extent of Pedestrian Connections

Factor #3: Support for Existing Communities:

Plan Consistency - State, Province, Local Plans

Right of Way - Existing vs. New ROW

Traffic Volumes -Increase vs. Decrease of Traffic

Factor # 4: Community Environmental Impacts:

Right of Way Category - Type of ROW Utilized

Travel Patterns - Diversion of "Thru" Traffic

Summary of Location & Environmental Impacts

Factor #5: Economic Impacts: Freight Mobility - Commercial Issues

Passenger Mobility - Commuter Issues

Economic Benefits - Amount & Extent of Economic Issues

Factor#6: Sustainability: Project Duration - Years before Additional Investment RequiredIntermodal Support - Number of Modes Addressed by Project

The Department identified the following seven goals that provide the framework for meeting the need of road infrastructure.

1. **Safety:** to achieve a significant reduction in traffic fatalities and serious injuries on all public roads
2. **Economic Vitality:** Promote and strengthen the economic vitality of the public through road development programs.
3. **Infrastructure condition:** to maintain the road infrastructure asset system in a state of good repair.
4. **Accessibility and Mobility:** Improve the accessibility and mobility of goods and all people.
5. **Freight movement and economic vitality:** to improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
6. **Environmental sustainability:** to enhance the performance of the roads while protecting and enhancing the natural environment.
7. **Reduced project delivery delays:** to reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

This process allowed the complex decision making process to be broken down into a series of paired comparisons ranking the importance of two criteria at a time. This process created a level of importance for each of the criteria based on the mission, vision and goals of the program and the percentages are found below:

Safety – 24.8%

Cost Effectiveness – 28%

Mobility/Accessibility – 10.6%

Impact on the Public/Social Disruption/Economic Justice – 16.15%

Environmental Impact – 15.45%

Road Infrastructure Preservation – 5%

Source: Pakistan Road Sector Development Program, Performance Evaluation Report, March 2016

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This section describes all the procedures that were undertaken to achieve the objectives set for in this study. The procedures that were adopted including all the information relevant to the collection of data, where those data were obtained from and how they were obtained are discussed. In addition, data and information sources, research instruments, sample size and method of analysis are presented. The succeeding sub section provides a general description of the research strategy adopted for this thesis, as well as justification of the methodology.

3.2 Research Design

Majorly, research strategies are categorized in two types and these are: quantitative research and qualitative research. The decision in the choice of the research type mainly depends on the type of study and availability of the information required for the study (Naoum, 1998).

Quantitative research is an objective measurement of a problem based on a theory composed of variables that can be measured in numbers; while qualitative research emphasizes meanings, experiences and descriptions to subjectively evaluate the opinion, view or perception of respondents towards a particular issue. For this research, both qualitative and quantitative type of research have been implemented, in view of the fact that it is possible to get adequate information from research questions that are related to the respondent's attitude, opinion and view coupled with desk study review of actual practice.

Hence, in order to achieve the objectives of the research, the research was carried out using the following six phases.

- **Theoretical Exploration:** The first is to undertake a literature search on previous related publications in connection with road project prioritization criteria and its application. Literature review is carried out throughout the whole research project, for the following main reasons:

- ✓ create an in depth understanding of road projects prioritization process and techniques;
- ✓ facilitate the identification of other countries road prioritization practices, and
- ✓ to support the assessment of the comparisons made between Ethiopia and other countries practice.

While conducting the literature review, information on the applicability of each prioritization criteria to different types of road projects as well as the different phases of projects, the rating mechanisms of each and any unique capabilities have been reviewed.

- **Conduct interviews:**An interview was made with the federal and rural roads authority representatives to understand the federal road projects prioritization practice.
- **Document Review:** several documents from the Ethiopian and Oromia Roads Authority were collected and reviewed thoroughly to establish an in depth understanding on the actual practice of federal road projects prioritization practice.
- **Questionnaire:** a questionnaire was developed and distributed to road users on the selected sample road projects as part of case study.
- **Desk study:** desk study was conducted on selected case study projects as to support and strengthens the questionnaire findings.
- **Data analysis and evaluation of desk study:** the data gathered from questionnaire and desk study on case study projects were analysed on thebasis of the objectives of the study. In addition, the gaps of Ethiopian road projects selection and prioritization practice for investment were identified.
- **Review of international practice and comparison with Ethiopian practice:** Taking the identified gaps in Ethiopian road projects selection and prioritization practice in to consideration relevant international practice was reviewed, and comparisons with Ethiopian practice were performed.
- **Conclusions and Recommendations:** from the analysis of the data as well as theliterature review, findings are developed and conclusions are formulated respective of theobjectives of the study and recommendations are then made from findings. Finally, furtherstudies related to this research are also recommended from the findings developed.

3.3 Method of Data Collection and Sampling Techniques

3.3.1 Method of Data Collection

Qualitative data were collected using primary and secondary method of data collections as described in the following section.

i. Primary data collection

Thesourceoftheprimarydatawouldbeinaformof interview and questionnaire on case study projects,designed to gatheradequate data(the road authorities' prioritization practice through interview and road users' opinion on its effectiveness through questionnaires).

a. Interview

The first research question was "what methods or practices are used to prioritize road projects investment in Ethiopia?". To answer this question an interview was conducted with the federal and regional roads authority's representatives.The interviews were the basis for exploring the nature of the road authority's prioritization techniques and challenges faced during such process.During the interviews the question 'why' has been co-occurrence to understand the purpose of a certain points. This approach is taken through interview questions which are geared at determining the meanings ascribed by the road planning officers to prioritization techniques; and the interview questions are builds from central/broadest questions up to several sub-questions in order to avoid limiting the research.Appendix 2 of this thesis contains the interview questions.

b. Questionnaire

In order to evaluate effectiveness of road projects and identify critical impact indicators that are required to be given due attention in order to improve the selection and prioritization practice of road projects investment,a questionnaire was developed and distributed to road users on the selected sample road projects as part of case study. The questionnaire was designed in such a way that it is clear, short and in line with specific and general objectives. It was also designed uniform in order toaccommodate all participants with choice for questions with a provision of giving

feedback and suggestionfor improvement of project prioritization techniques at the planning stage, wherein the sample of the questionnaire is attached in Appendix 3.

ii. Secondary data collection

Secondary data, which involves information from road authority's guidelines, reports and different documentswerereviewed to clearly understand the road authorities' prioritization practice and compliment the primary data. In addition, published text such as academics periodicals, research journals, government publications, dictionaries, past dissertations and Internet resources were reviewed.

a. Desk study

Severaldocuments from the Ethiopian Roads Authority were collected and reviewed thoroughly to establish an in depth understanding on the actual practice of federal road projects investment prioritization practice. Regarding rural road projects, some documentssuch as feasibility study reports of the selected sample project could not be availed by the respective roads authority. Only one project's feasibility study report was found but could not be used as a reference for rural road projects since it was prepared on urban road project feasibility study. In addition, to demonstrate the effectiveness of (URRAP) projects,the "Mid Term Impact Evaluation Report"(which was made in comparison with baseline) was reviewed.

Generally,the collected documents included, but not limited to, the following:

- Borrower's Implementation Completion Report (June 2015) by ERA;
- Design document, progress report, completion report and Consultants' EIA report (case study projects);
- ERA Design Manual, 2002;
- ERA GTP I Plan Five years (2003-2007) and EFY 2007 Performance Report;
- ERA GTP II Plan;
- Feasibility Study Reports of 4 projects under ERA, which are recently conducted within the past five years (from 2012 to 2017);
- ORA GTP I (2003 – 2007 EFY) Evaluation Report;
- ORA GTP II Plan;
- Oromia Region Road Network Master Plan Study, 2012;

- Road Sector Development Program, 19 Years Performance Assessment Reports, 2016;
- Road Sector Development Program (RSDP) 13 Years Performance, 2010;
- Transport and Poverty Observatory Study by ERA, 2007; and
- 2ndYear Survey Report for the Impact of Rural Roads Constructed under URRAP, 2016.

3.3.2 Sampling Techniques

i. Interview Sampling

The persons to be interviewed from the roads authorities (Ethiopian Roads Authority and Oromia Rural Roads Authority) are identified. Those individuals were selected from planning departments of the roads authorities, who have direct involvement on the subject matter and relevant to the study.

ii. Case Study Sampling

The 2nd research question was "what are the challenges and gaps of the current road projects investment prioritization practice in Ethiopia?". In order to obtain answer for this question,completed and ongoing projects were chosen for case study as to find out the answer for these questions. Four projects were selected to assess the road users' and stakeholders' opinions that demonstrate the effectiveness of the current road projects investment prioritization practice in Ethiopia.

Two recently completed road projects were selected fromthe Ethiopian Roads Authority out of fourteen projects to evaluate the federal road projects. Additional two road projects which were selected from ORA,which were the only completed projects in 2016 and included in the Regional Road Network Master Plan Study;these were meant to observe the rural road projects' effectiveness towards prioritization methods.

The sampling technique used to select ERA's projects for the case study considered the following features.

- Recently completed project in 2009 of Ethiopian budget year,
- Projects commenced with in GTP I plan,
- Project financed by Government of Ethiopian, GoE

- Availability of enough data about the project, and
- Projects located nearby Addis Ababa.

With this consideration, out of 14 projects those are completed in 2016/2017 two projects were selected as discussed here under;

- Four projects are said completed and inaugurated but the completion report is not completed yet.
- Two projects have not enough data such as Environmental Impact Assessment report and Detail Engineering Design Report.
- Six projects are located more than 500km on average from Addis Ababa.
- Two projects (those are selected for case study) have required data and located nearby Addis Ababa City (on average distance of 50 to 100 km).

As some of the projects selected for this study did not officially inaugurated, it is decided not to mention the names of the projects and hence, projects are identified with ID numbers, for the sake of confidentiality. However, all the required data has been gathered and included in the study.

The number of project in the case study was limited to four basically for the limitation of budget and time.

iii. Questionnaire Sampling

The questionnairewas developed for determining the road users and stakeholders' opinionson the road projects planning practice and its effectiveness to be able to identify the road projects'critical impact indicators. The participants of the study were the regional road transport offices, direct road users and different project stakeholders.This research method is conducted through thequestionnaire distributed to selected road users and regional road transport offices.

Accordingly, five Zonal Roads Authorities in Oromia and Amhara regions were selectedwith their offices located in Addis Ababa and these were: East Shewa Zone (Adama), West Shewa Zone (Ambo), South-West Shewa Zone (Wolisso), North Shewa Zone (Debrebrhan and Fiche). In addition, a minimum of one woreda was

included in the questionnaire for each project. The selected Woredas and Zonal road agency officials were considered in the survey.

Furthermore, to collect comprehensive and demonstrative data, persons with differentprofessionals disciplines, age, and job were involved in the questionnaire. Since the participants were at different level of educational background, the questionnaire was translated into their respective local languages; and in some cases, the responses to the questionnaires were performed through interviewing process.A copy of questionnaire is included in the Annex 3 of this thesis.

3.4 Analysis of the Research

The data gatheredthrough interviews, questionnaire and desk study were analysed on thebasis of the objectives of the study.Such analysis includes evaluation of study parameters reviewed from different road feasibility study and other reports against the identified road projects investment prioritization criteria. This was done to confirm whether the actual prioritization practice exercised the identified available criteria.

In addition, the responses acquired through the questionnaires were analyzed. The method used to analyze the questionnaire data wasdescriptive statistics.This method of analysis helps to analyze the responses in actual numbers. The data analysis included the stages of data processing, putting answers into categories and generally finding out the pattern of the responses.

In the analysis, the "Mean Score, MS" or "Average Index" method is adopted to establish the relative importance of different factors in association with selection and prioritization of road project. Accordingly, Likert's Scale of three ordinal measures of agreement towards each statement (1, 2, 3) is used to calculate the MS of each parameter stated under the corresponding questionnaire categories. A Likert scale is, simply, a statement in which the respondent is asked to evaluate according to any kind of subjective or objective criteria. In this technique, generally, the level of agreement or disagreement of respondents is measured. The reasons for adopting this simple scale are:

- To provide simplicity for the respondent to answer; and

– To make evaluation of collected data easier.

In a Likert scale, the respondent is asked to respond to each of the statements in terms of several degrees, usually five degrees (but at times 3 or 7 may also be used) of agreement or disagreement.

The analysis will rank the factors based on the frequency analysis and mean score/average index. This index was calculated as follows [AbdMajid&McCaffer, 1997]:

$$MS = \frac{\Sigma(f \times \mu)}{N} \quad \text{..... Eq. [3.1]}$$

Where:

MS – Mean Score

f– Frequency of responses for each score

μ– Score given to each factor by respondents (1 to 3)

N – Total number of responses concerning each factor

Whereby the application of Average Index in questionnaire for instance would be:

$\mu_1 = 1$, frequency of "not at all" response = low degree of considerations

$\mu_2 = 2$, frequency of "partially" response = Medium degree of considerations

$\mu_3 = 3$, frequency of "Significantly" response = High degree of considerations

These average indexes could be further interpreted back to reflect the respondents, [AbdMajid&McCaffer, 1997] used discrete scale converted to a continuous index, which then can be split into discrete categories.

- Not at all ($1.0 \leq$ Mean Score < 1.5)
- Partially ($1.50 \leq$ Mean Score < 2.5)
- Significantly ($2.50 \leq$ Mean Score ≤ 3.0)

The percentage of respondents is also calculated to determine the frequency of factors raised by respondents corresponding to open ended questionnaires.

Based on questionnaire findings, an assessment was made on the effectiveness of Ethiopian road projects investment prioritization practice and identified critical impact indicators as to find out the gaps of current practice. A detail of questionnaires analysis is attached in Appendix 4. Accordingly,relevant international road projects investment prioritization practiceshave been reviewed and examined towards addressing the gaps assessed from case study on Ethiopian practice.At the end, comparison was made between the Ethiopian and international investment prioritizations practices in order to recommend improvement action for the gaps found out on Ethiopian selection and prioritization practice.

3.5 Results

From the analysis of the questionnaire and desk study made on selectedcase study projects critical impact indicators were assessed and the gaps on Ethiopian road projects investment prioritization practice were identified.

The 3rd research question is: "How should the Ethiopian road project decision-making process be strengthened to optimize the scarce financial resources for the road infrastructure investment where they would achieve the greatest impact?"

Accordingly, review of relevant international road projects investment prioritization practiceswas done as to make comparisonswithEthiopian practice and recommendation was forwarded on the action to be taken to improve the gaps found out on Ethiopian practice.

CHAPTER FOUR
DATA ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Findings from the Interviews

4.1.1 Road Projects Selection and Prioritization Practice for Investment

4.1.1.1 The Ethiopian Roads Authority (ERA)

An interview was made with the Ethiopian Roads Authority Project Planning Section Head to understand the Federal road projects investment prioritization practices as presented here under.

i. Project identification process

It is noted from the interview that the project identification process is based on the following:

a. Projects identified by regional roads authorities

In this process the projects will be identified and ranked by regional roads authorities and recommend to ERA for implementation.

b. Projects identified by the ERA

In such cases, ERA will identify new roads for construction and existing roads for rehabilitation. In the case of new road projects, ERA givespriorities to accessibility (location that needs an access road which does not have any road in that area). ERA alsoconsiders roads with traffic overflow (if the existing road could not accommodate the existing traffic, new alignment will be identified). On the other hand, in the case of road projects for rehabilitation, the main factor for identification of projects is traffic surveys (seasonal traffic surveysare conducted by the Road Asset Department) and existing road condition expressed in terms of International Roughness Index (IRI). If the Annual Average Daily Traffic (AADT) of such project exceeds the capacity of existing road standard, it will be selected forrehabilitation/upgrading.

c. Exceptional projects

Exceptions can be made for some projects based on national policyprogramssuch as; food security, security problems, import-export corridor, industrial zones, and new

infrastructure areas like dams or sugar factories. In such cases,the above criteria maynot be considered for identification or prioritization of such kind of projects.

In addition, it was learnt duringthe interview that through the project identification process, ERA would not;

- verify that the identified road projects on regional/zonal level were selected based on an appropriate criteria;
- directly consult the communities when/before selecting the projects; and
- perform its own public needs assessment regarding road demand**.**

ii. Project prioritization process

a. Available criteria

ERA has its own criteria to prioritize road projects (5 criteria for new roads and 5 criteria for rehabilitation/upgrading projects); and those criteria were established on ERA 1st GTP. For rehabilitation projects, the main criteria are current traffic load (AADT) and for new projects, accessibility and traffic overflow are the main criteria. For detailed information on criteria, the interviewee recommended to refer to the Road Sector Development Program (RSDP) of the nineteen(19) years accomplishment report. Hence, details of the said criteria and theweighting are discussed in section 4.2.1.1. (ii).

b. Practical use of ERA road projects investment prioritization criteria

Though the identified projects will not be properly analyzed/calculated based on the available weightings criteria, the interview shows that all criteria would be addressed and checked at the project feasibility study stage. To confirm the said process, different projects feasibility study reports were reviewed, and thefindingsare discussed in section 4.2.1.2.

c. Effectiveness of the ERA road projects investment prioritization practice

Itwas confirmed from the interview that ERA would not perform projects' post-evaluation studies on government-financed projects due to shortage of adequate expertise (though this is not a convincing reason, they can hire consultants). Hence, there is no means to verify the constructed project's effectiveness and whether they

are giving the desired benefits. For some projects that are constructed for the purpose of poverty reduction or access provision for investment/infrastructure areas, the effectiveness would be confirmed indirectly when the main objectives gavepositive impacts. In addition, feedback assessment would not be carried out from the public and its own road asset management department on the constructed roads. Furthermore, since the establishment of prioritization criteria within ERA, evaluation and/or revision of such criteria have not been performed.

However, in this research, the criteriaand current prioritization practice effectiveness were evaluated on selected projects as part of a case study through questionnaire and desk study, and the findingsare presented in section 4.3 (case study).

In general, ERA's representatives/interviewee believed that though there are some challenges and gaps in the road sector, its overall performance was good for the last two decades in improving the country's road networks and road conditions.

4.1.1.2 The Oromia Roads Authority (ORA)

In order to assess the regional/rural roads authorities' road projects investment prioritization practice, an interview was conducted with the Oromia Roads Authority planning officer. The discussion made during interview is presented here under.

Within ORA, the road projects implementation practice is categorized in two groups; the first one is on projects that will be implemented through the Region's capital budget, which is called capital projects and the second one is on projects that are implemented under URRAP through the Federal Government Budget. This research is mainly focused on the capital projects selection and prioritization practice within ORA, since URRAP projects are performed at zonal/woreda level.

i. Project identification process

It was learnt during interview that the following project identification processesare practicedby ORA:

a. Projects identified by zonal roads authorities

Zonal demand, originally initiated by the communities through focus group discussionswould be assessed and the identified projects will be forwarded to ORA for implementation.

b. Projects identified based on new government policies

Some projects would be selected based on the current national policy; for instance projects identified through zonesand passed toworeda touch program.

c. Projects identified by the Authority 5-years strategic plan

The Authority every five (5) years will prepare a strategic plan for implementation of different new and existing road projects for budgeting purposes, which is called the Growth and Transformation Plan (GTP) Nos. I &II. Based GTP, the identified projects would be considered for implementation.

ii. Project prioritization process

a. Available criteria

It was learnt during the interview that ORA does not currently use clear guideline/criteria for prioritization of road projects. However, ORA conducted the Oromia Region Road Network Study through consultants in 2012. However, ithas not been implemented so far due to some government policy changes such as URRAP (since most of the road network study objectivescould be addressed through this program), according to the interview discussion.

On the other hand, it is understood that usuallyORA has been exercising the following regional/rural road projects investment prioritization criteria, though it is not officially communicated or considered throughout the authority as a guideline.

- **Zone to Woreda touch**: roads that connect wordas to zonal seat were given priority;
- **Zonal road network**: zones with low road density were given priority based on percentage of such zones' road network;
- **Population density**: roads located in an area with high population density were given priority, though it is located in zones with high road density, since it is considered to serve large group of population;
- **Best road network**: roads that have best routes connecting two or more woredaswith one route were given priority due to its economic advantage; and
- **Potential investment areas**: roads that would access to potential investment areas were given priority.

b. Practical use of ORA road projects investment prioritization practice

The results of the interviews show that all criteria would be considered during prioritization of road projects; however, there is no weighting for each criteria to evaluate all projects on equal basis.Thus, the final decision of ranking the projects would be subjective andmay be open for bias.According to Turochy and Willis (2006),a rational procedure of ranking of development projects is defined as "one with clear steps and a sequence". This idea is critical as it distinguishes between a systematic methodology that can be consistently replicated versus one without a well-defined structure, since a non-rational process is open to the bias of the evaluator.

Hence, in evaluating the ORA's current road projects ranking, those that are implemented/ ongoingsince 2012 (after road network study establishment) against its initial road network studywas found necessary. In this evaluation, the ORA road network study report and the GTP I&II reports were reviewed. In addition, in order to verify whether some of the ORA road network study objectives were addressed through URRAP, a report on impact of URRAP projects was reviewed and evaluated against the road network study objectives. The finding of such review is presented under section 4.2.2.2.

c. Effectiveness of ORA road projects investment prioritization practice

It is confirmed from the interview that ORA has never performed post-evaluation of projects to confirm whether the roads are giving the desired outcomes.However in this research,the ORA road projects investment prioritization practice effectiveness was evaluated on selected projects as part of the case study through questionnaire and desk study, and the findingsare presented in section 4.3 (case study).

4.1.2 Challenges in the Ethiopian road projects selection and prioritization practices for investment

Challenges that the Roads Authorities have faced in projects selection and prioritization process were discussed during interview and those emphasized are summarized hereunder.

- **Budget limitation**:road network development and available budget are not sufficientconstraining the Roads Authorities from performing as planned.
- **Rapid rate of traffic growth**: due to rapid rate of traffic growth, the roads authorities are forced to plan new alternative projects for such roads like constructing expressways, which require large amount of budget.
- **Regional competition**: excessive access demand and/or unnecessary road standard may berequired by the regions without the roads traffic demand due to regions competition which triggers misallocation of resources/budgets.
- **Excessive public demand**: community excess demand in route selection by choosing/demanding un-economical(not feasible) route and road standard, and demanding extra/unfair compensation that wouldsignificantly affect the construction progress.
- **ERA, ORA, local consultants and contractors capacity problem**: the capacity problem of local consultants and contractors resultsin invitation of foreign consultants and contractors involving foreign currency that significantly raiseproject costs; quality problem that results in high maintenance costs and early deterioration before the design life; and cost and time overruns that causes budget limitation to implement new projects.
- **Lack of integration with other infrastructure development institutions**: poor practice of integration resulted in an unexpected/unplanned road projects for implementation.
- **Decision makers' interest**: sometimes skewed process may occurat the planning stage due to decision makers special interest.
- **Incidental situation**: incidental instruction may occur due to newly outlined government policy that would adversely affect the planning process such as poverty reduction policy, developing new corridor, etc.
- **Lack of accident record**: due to unavailability of proper recording system of accidents, road projects are usually studied/designed without inclusion of accident impacts; and lacks road safety plan.
- **Poor maintenance practice**: lack of proper maintenance as per its maintenance strategicplan may cause an early deterioration, which require overlay or emergency recovery.

- **Lack of project post-evaluation study**: to see whether the project has given the expected outcome, performing the projects post-evaluation study is critical which gives good feedback for the future projects.

4.1.3 Suggestions given by the interviewees

The interviewees gave the following suggestions as to improve the current road projects selection and prioritization practice:

- Decision makers must have technical and managerial skills that enablethem to understand the impact of their decisions on the road sector;
- Senior staffs must get involved to transfer knowledge and establish good trends for future road selection and prioritization practice;
- Roads authorities must have enough qualified expertise in planning departments since development of roadsis backbone of the sub-sector;
- The capacity building program of local contractors and consultants must be improved to reduce foreign currency expenses, quality problems and the consequences of early termination of road projects;
- Procurement policy must be reviewed to avoid least bidder challenges;
- Responsible implementation sections of the road authorities must be strong in monitoring the execution of planned projects with regard to quality, cost, time and execution of social & environmental management plans; and
- Roads authorities should improve their maintenance management practices.

4.2 Findings from Document Review

4.2.1 Ethiopian Roads Authority (ERA)

4.2.1.1 Road projects selection and prioritization practice for investment

i. Road projects selection practice

It is noted from the interviews that ERA is using two ways of road projects identification process in respect of projects proposed from regional roads authorities and projects identified based on its strategic plan, though there are exceptional projects. In addition, during review of the ORA Road Network Master Plan Study Report, a list of road projects that were proposed to ERA for paving with surface treatment in 2012 was observed. In order to confirm the stated proposed projects' statuses, road projects in the Oromia Regionthat are currently under implementation

and planned for implementation by ERA werereviewed using the ERA GTP II Report. Table 4.1below presents the status of the proposed road projects.

Inthe table, it was observed that neither roads with higher AADT nor roads proposed for immediate upgrading by ORAgot priority for implementation. Road projects that were under implementation and planned for implementation were not in line with ORA proposal or ERA's planning requirement (for rehabilitation projects the main factor for identification of road projects at the ERA is AADT, as per the interview made with ERA representative).

Table 4.1: Status of proposed road projects from Oromia region against ERA's current projects

Name of Road Projects	**AADT in 2012**	**Projects as per ORA Road Network Study**	**Actual Project Status as per ERA GTP II Plan**
Chanka – Gidame	397	Proposed to ERA in 2012 to be paved with surface treatment	Planned to commence in 2018 with DBST
Meki – Agolto – Gonde	252		Under feasibility study stage
Hambiso – Edjere	297	Proposed to ERA in 2012 to be paved with surface treatment	Not included in the GTP II plan (not selected yet)
Bedesa – Bososo	175		
Guder – Shenen	173		
Bishoftu – Sendafa	90	Bringing to good condition by ORA	Planned to commence in 2017 with AC
Ayana – Hide – Kelo	22		Under feasibility study stage
Koka – Adulala – Bishoftu/Debrezeit	83	Planned to be upgraded to Surface Treatment (2023 – 2027)	Under construction with AC standard (commenced on 2015)

ii. Road projects investment prioritization practice

As per the interviewee recommendations,the ERA RSDP 19 years performance report and the GTP I&II reports were reviewed to assess the ERA project selection and prioritization practices; and the observations are summarized here under:

The early stages of project selection and preliminary prioritization were based on a multi-criteria approach(MCA), described in the sections below. After preliminary selection using the MCA approach, the project preparation moved to feasibility studies stage where a detailed economic and environmental analysis was carried out. Furthermore, ERA would also prepare and perform Resettlement Action Plan (RAP) as inseparable tools from EIA to ensure the livelihood of the project-affected persons maintain pre-project status or even improved.

a. Preliminary Selection of Road Upgrading Projects

Five criteria were used for preliminary selection of road upgrading projects. These criteria were:AADT on the proposed road; network connectivity; road condition; investment potential;and import-export road. Each of these is dealt with as follows:

- **AADT**: Roads are built with a design capacity to accommodate a given volume of traffic per day. When traffic levels exceed the design capacity, roads reach to the point where maintaining them is no longer economical. Roads with high traffic are given priority for upgrading or rehabilitation with 30% weight.
- **Network Connectivity**: Existing roads, particularly main roads, are connected with other roads that collect and feed in traffic. Roads which improve the efficiency of the road network connectivityare given priority for upgrading with 20% weight.
- **Road Condition**: Those gravel and asphalt roads that had passed their initial design lives and had deteriorated to the point where maintaining them is no longer economical. In such cases, it was impossible to restore them to their original condition by heavy maintenance and reconstruction and so upgrading was necessary to bring them back to a serviceable standard. Priority is given to roads or sections of road that were in a poor condition with 20% weight.
- **Investment Potential**: The number of medium and large-scale industries under a licensing phase or under implementation in emerging towns of the country was accelerating. Absence of road infrastructure was frequently cited as the main impediment to existing industries and this was also an investment restraint to attract new industries. Lack of adequate road infrastructure also hampered growth of the economy at the national level and priority is given to upgrading roads, connecting with these towns with 10% weight.
- **Import/Export Corridor and Regional Integration Roads**: Ethiopia imports and exports goods mainly through the port of Djibouti and to some extent through the ports of Berbera in Somaliland and the port of Sudan. Ethiopia is also planning to use the port Mombasa in Kenya as an alternative outlet. Upgrading roads linking to ports of neighboring countries was important as they provide alternatives and promotes competitiveness. Ethiopia also needs to ensure links with neighboring countries to improve trade and promote regional integration.

Priority is given to upgrading import/export and regional integration corridors and this factor is rated at 20% weight.

b. Preliminary Selection of New Roads

Five criteria are applied for preliminary selection of new roads. These criteria are: roads leading to economic development by exploiting potential areas; roads leading to foodsurplusof subsistence and cash crop growing areas; missing links between main roads or shortcuts; new access to large population centers and roads in emerging regions. These are succinctly presented below:

- **Economic Development Potential**: Ethiopia is endowed with natural resources in different parts of the country, mainly irrigable potential agricultural land and minerals, which are not exploited yet. Priority is given to the construction of new roads providing access to areas with unexploited natural resources and this is rated at 20% weight.
- **Subsistence and Cash Crops Growing Areas**: Some areas grow and supply surplus food crops to urban and rural markets and to food deficit areas. In addition, there are areas producing exportable crops (cash crops). Not all of these surplus food crops and cash crops growing areas were connected by roads. To improve thus supply of food crops to urban and rural markets and increase the volume of exportable crops, construction of new roads linking to these areas is vital. Priority is given to the construction of new roads creating access to these areas and this is rated at 20%.
- **Missing Links**: Several towns in the country are linked to each other by circuitous roads and connectivity of the road network is not optimized. Consequently, transportation costs and travel times are high between these towns. Costs and time of travelling could be reduced significantly by constructing link or short access roads between some towns in the country and priority is given to the construction of link roads and this is rated at 20% weight.
- **New Access to Population Centers**: There are large rural communities in different parts of the country whichare totally isolated from the rest of the country because of the absence of roads. These communities are needed to become socially and economically integrated with the rest of the country. By the virtue of this, priority was given to the construction of new roads providing access to large isolated rural communities in the country and this is rated at 30% weight.

- **Emerging Regions/Isolated Areas**: There are four emerging regions in the country namely Gambella, Benishangul-Gumuz, Afar and Somali. In the past, distribution of main roads in these regions and some pastoral areas of the country had been minimal. To bring about balanced development amongst the regions in the country, roads provision should be equitable. Accordingly, priority has been given to construction of new roads in these emerging regions and this is rated at 10% weight.

c. Final Prioritization and Selection

It is as a result of feasibility studies that final project selection would be made on the basis of economic viability. All new construction and upgrading projects are selected based on the conventional Producer Surplus Approach or Highway Development and Management (HDM 4) Tool analysis results, as found appropriate in order tocompare the total costs with the total benefits discounted at the opportunity cost of capital of 10.23%. Generally, total project costs include: construction and maintenance costs during the service period of the road. Similarly, benefits include: vehicle operating cost and travel time savings. Each project is assessed based on Economic Internal Rate of Return (EIRR) and Economic Net Present Value (ENPV).Public roads are evaluated by accounting for economic costs where Economic costs are calculated by deducting transfer payments from the financial costs.

Feasibility studies for most of the roads ear-marked for upgrading or new construction were well underway or well advanced. Finalization of procurement for civil works and consultancy for those projects scheduled to start in the early years of the program was well advanced.

The Roads Economic Decision Model (RED), developed by the World Bank, is also used to improve the decision-making process for the development and maintenance of low-volume regional roads. The model performs an economic evaluation of road investment options using the consumer surplus approach and was customized to the characteristics and needs of low-volume roads.

4.2.1.2 Practical use of road projectsinvestment prioritization criteria

As discussed undersection 4.1.1.1 (ii)no document was found that shows prioritization process and the said criteria applications. Therefore, four projects'feasibility study

reports (two upgrading and two new projects) were reviewed in this case to verify whether the above-mentioned criteria were really addressed at feasibility study stages as specified duringthe interviews. These sample projects were selected as per ERA's recommendation those represent federal road projects and recently conducted feasibility study of new and upgrading of link roads. The review findings are discussed as follows.

i. Parameters considered during the feasibility study of road projects

a. Road upgrading Projects

Summary of Road Upgrading Projects' Feasibility Study Parametersare summarized inTable 4.2 below.

Table 4.2: Summary of Road Upgrading Projects' Feasibility Study Parameters

Attributes	Ambo – Wolliso Road Upgrading Project	Wolkite - Hossana Road Upgrading Project
Project Location	Oromia region	Southern region of Ethiopia
Project length	63.8 km	124 km
Project objectives	✓ To create link between two trunk roads that is Addis Ababa – Nekempt Trunk Road and Addis Ababa – Jimma Trunk Road; ✓ To connect two zonal capitals that is: Ambo (West Shewa) and Wolliso (South West Shewa) of the Oromia Regional State. ✓ The Project Road traverses mainly agricultural areas with small towns like Wenchi (some 27 km from Ambo) and Chitu (about 9 km from Wolliso); ✓ The Project Road also traverses several small villages along the route with small open markets; and ✓ At the town of Wenchi, there is a junction to the Crater Lake (Wenchi) - on the left side coming from Ambo - that is the major tourist destination in the corridor and is presumed to continue to attract more tourists to the Area after the development of the Project Road.	✓ To connect two important routes that is Addis Ababa – Jimma Trunk Road and Addis Ababa – Butajira – Hossaina – Sodo Road; ✓ To create direct link between Gurage,Silte, Hadya, Wolaita and other zones in the Southern Region; and ✓ The Project Road traverses 17 towns and villages with moderately cultivated land coverage.
Average AADT	236 (normal traffic on baseline survey).	373 (normal traffic on baseline survey).
Existing Road	A natural gravel/earth surface in bad condition with an average width of 6m, pavement thickness of 15 mm and surface roughness IRI of 14.	Gravel surface in bad condition with an average width of 7m, pavement thickness of 20mm and surface roughness (IRI) of 12.5.

Attributes	Ambo – Wolliso Road Upgrading Project	Wolkite - Hossana Road Upgrading Project
Opportunity Cost of Capital	10.23%	10.23%
Upgrading alternatives	Asphalt Concrete (AC) with a total capital cost of ETB 1,072,358,534.66 and Double Bituminous Surface Treatment (DBST) with ETB 948,851,458.82.	Asphalt Concrete (AC) with a total capital cost of ETB 665.94 million and Double Bituminous Surface Treatment (DBST) with ETB 540.54 million.
Economic Evaluation	✓ AC with NPV of ETB 458.39 million and EIRR of 14.6%; and ✓ DBST with NPV of ETB 222.638 million and EIRR of 12.6%.	✓ AC with NPV of ETB 378.2 million and EIRR of 18.5%; and ✓ DBST with NPV of ETB 335 million and EIRR of 19.5%.
Recommended alternative	AC	AC

b. New road projects

New Road Projects' Feasibility Study Parameters are summarizedinTable 4.3 below.

Table 4.3: Summary of New Road Projects' Feasibility Study Parameters

Parameters	Ankober - Awash Road Project	Dembecha – Feresbet - Adet Road Project
Project Location	Amhara and Afar Region.	Amhara Region.
Project length	93.13 km, a section of Debrebrhan – Ankober – Awash Road Project.	125 km.
Project objectives	✓ Provide a link between Addis Ababa – Dessie Trunk Road and Addis Ababa – Awash – Djibouti Trunk Road. ✓ Create suitable route for passage of heavy goods vehicles traveling to/from the port of Djibouti and towns along Addis Ababa – Dessie Road from Debrebrhan towards north to Dessie. ✓ Open up new alignment/access that reduces a significant travel distance of 225 km for the journey between Awash Arba and Debrebrihan. ✓ Provide link for the people in two regions Amhara and Afar and promote the socio-economic integration of the people in the regions, to open up the area for development. ✓ The Project Road traverses 7 rural and urban towns and villages.	✓ Provide a link between Debrebrhan - Bahirdar Trunk Road and Dejen – Mota – Bahirdar Trunk Road. ✓ Open up a short cut access between the project area and regional capital, Bahirdar. ✓ The Project Road traverses mainly the rural areas of four Woredas, which are extensively cultivated with cereal crops and a source of timber trees.
Opportunity Cost of Capital	10.23%	10.23%

Parameters	Ankober - Awash Road Project	Dembecha – Feresbet - Adet Road Project
Average AADT	✓ Diverted traffic from adjacent roads is considered as a main source of traffic.	133 (normal traffic on baseline survey with 25% of expected diverted traffic and 30 generated traffic).
Alternatives of road construction	Asphalt Concrete (AC) with a total capital cost of ETB 1.342 billion and Double Bituminous Surface Treatment (DBST) with ETB 1.329 billion.	Asphalt Concrete (AC) with a total capital cost of ETB 2.4 billion and Double Bituminous Surface Treatment (DBST) with ETB 2.28 billion.
Economic Evaluation	✓ AC with NPV of ETB 397.57 million and EIRR of 14.3%; and ✓ DBST with NPV of 359.22 million and EIRR of 14%.	✓ AC with ENPV of ETB 968.76 million and EIRR of 15.9%; and ✓ DBST with ENPV of ETB 897.46 million and EIRR of 15.7%.
Recommended alternative	✓ Most economically viable alternative: AC	✓ AC

ii. Evaluation of prioritization criteria based on feasibility study parameters

a. Roadupgrading projects

- Traffic Level (30% weight): when the traffic level of the road exceeds the existing road design capacity.
  - ✓ AADTs of the two projects were 236 and 373. As per ERA Design Manual (2002),the design standard for traffic level from 200 to 1,000 is DS4 (paved surface type). Therefore, maintaining the existing gravel road of both projects will no longer be economical since the traffic level significantly exceeds the design standard of gravel road (unpaved surface type for traffic level less than 100).
- Network Connectivity (20% weight): roads that improve the road network connectivity.
  - ✓ As it is shown in the project objectives, both projects provide a link between different trunk roads and connect different zones and woredas/villages along the project route that improve the road network connectivity.
- Road Condition (20% weight): roads in poor condition
  - ✓ Both roads were in a bad condition with a surface roughness (IRI) of 14 and 12.5.

- Investment Potential Areas (10% weight): roads that improve the existing industries and attract new industries and give economic growth at the national level.
  - ✓ Though the projects' objectives were not to give access for investment potential areas it is believed that they provide some contribution for growth of economy at the national level since both project roads traverses agricultural and market places.
- Import/Export Corridor and Regional Integration (20% weight): roads that improve import/export and regional integration corridors.
  - ✓ Apparently, the selected two sample upgrading projects are located in the central part of the country and they would not provide any contribution to improve import export corridors.

From the above discussions, it can be noted that the prioritization criteria of road upgrading projects are addressed at the projects feasibility study with no consideration of the stated weights.

b. New road projects

- Missing links (20% weight): roads that reduce cost and time of traveling.
  - ✓ Both roads create/ open up a short cut access. Especially, theDebrebrhan – Ankober – Awash Road Project significantly reduces (about 225km) of travel distance.
- Subsistence and cash crops growing areas (20% weight): roads that provide access to some areas whichgrow and supply surplus food crops to urban and rural markets and to food deficit areas and increase the volume of exportable crops.
  - ✓ Dembecha – Feresbet – Adet Road Project traverses mainly the rural areas of four Woredas, which are extensively cultivated with cereal crops and a source of timber trees.
  - ✓ Debrebrhan – Ankober – Awash Road Project is also expected to create access for Afar region to import foods from the nearby market since 50% of the regional populations are food deficit on annual basis, as per the strategic development program of the regional government.
- New Access to Population Centers (30% weight): providing access to large isolated rural communities.

- ✓ Both projects traverse rural areas giving access to population within the project areas. Besides, the construction of the Dedbrebrhan – Ankober – Awash Road Project will link the people of the two regions contributing to development of the areas.

- Economic Development Potential (20% weight):
  - ✓ Though creating access for economic development potential areas were not the objectives of both projects, it is however expected that the projects will have corresponding positive impacts, including opening up of market opportunities, providing access to improved and better social service facilities, and creating investment and employment opportunities.
- Emerging Regions/ Isolated Area (10% weight): To generate balanced development amongst the regions in the country.
  - ✓ Debrebrhan – Ankober – Awash Road Project might be considered for this criterion, as some section of the project is located in Afar region (which is considered as an emerging region).

In general, it is learnt from the above discussion that prioritization criteria stipulated for new project roads are moderately addressed by considering the projects feasibility study although not satisfactory.

iii. Evaluation of final prioritization and selection criteria based oneconomic feasibility study parameters

All new and upgrading projects were analyzed and compared based on total costs and benefits as per ERA final prioritization criteria. As it was noted from feasibility study parameters of the selected sample projects, economic viability evaluation was performed with different road standard alternatives and the most economically viable alternatives were selected based on NPV and EIRR values. Hence, the final prioritization and selection criteria were addressed through respective feasibility study.

However, it is understood from the review of projects' feasibility studies that the Environmental and Social Impact Assessment and Resettlement Action Plan preparation were performed after completion of feasibility study. This implies that there is no means of rejecting the road projects that would have significant negative

impact on the environment and social values other than preparing mitigation measure whether the impactsare fully mitigated or not. In addition, it is observed from feasibility studies that ERA has not considered the impact of accident in the economic analysis model,HDM 4.

Regarding the overall application of ERA road projects prioritization criteria under the current practice, the criteria specified for prioritization of road projects would be verified through feasibility study of the project roads. However, the results of the document reviews revealed that the feasibility studies of the projects only shows the viability of that specific projects without giving score, and hence comparison/ranking would not be performed between projects based on the said prioritization criteria weighting.

As discussed in the literature review section, evaluation methods are needed to help the politicians or decision-makers to rank and choose the projects based on their costs, benefits and impacts to the best of the society's welfare.

In addition, the weighted total score aims at "assisting decision makers to realize the time-order of implementation within the desired time horizon", which refers to short-, mid- or long-term respectively, according to Tsamboulas, (2007).

4.2.1.3 Effectiveness of road projects selection and prioritization practice for investment

As it was learnt from the interviews, ERA has not conducted ex-post evaluation studies for government-financed projects. During the document collection and review stage performed at ERA, different projects post-evaluation reports were found such as:Borrower's Implementation Completion Report (June 2015) by ERA and Transport & Poverty Observatory Study by ERA. However, all projects included in the said post-evaluation study were not government-financed projects; and independent consultants as per the financiers' requests carry it out which were initially agreed on.

However, in order to evaluate the effectiveness of ERA current road projects selection and prioritization practice, a case study was conducted on selected two government financed projects under ERA by developing questionnaire and performing desk study, and the findings are presented in section 4.3 (case study).

4.2.1.4 Challenges in road projects selection and prioritization practice for investment

From document reviews performed in ERA, it was observed that ERA has faced different challenges in performing its plan, under GTP Ias well as under the 19 year RSDP. The major challenges considered in the ERA GTP I and 19 years RSDP performance reports are summarized hereunder:

- **Delay in construction and poor quality of construction:** Road projects are intended to be executed within a given period of time and to be functional for a desired period of time. Not completion of the projects within the planned period would result in budget limitation for the upcoming projects by causing inflation of costs resulting in loss of the project's desired benefit. In addition, one of the major challenges in the Ethiopian construction industry that inhibits the projects from performing the desired function is poor quality of construction. In such cases, economically feasible road projects would not serve until end of the design period resulting in underestimation of the benefitswhich were envisaged at the planning stage and thus would cause economic and social loss to the nation.

  Regarding poor implementation of Road Projects in respect of Environmental and Social Management Plan,Environmental and Social Impact Assessment (ESIA) was used as a tool before the Environmental Impact Assessment (EIA) proclamation was issued and legally required procedure since 2002. Since then, all road projects had to pass through EIA process including small projects like bridge construction and heavy maintenance. In addition, ERA has developed guidelines to attain the required quality of EIA; and is supporting project contractors to develop Environmental Management Plan (EMP) in advance of construction commencement, regularly monitoring projects and finally making reinstatement works as a precondition for project hand-over. However, its effective implementation has not been satisfactory, though it is improving from time to time.

4.2.2 OromiaRoads Authority (ORA)

4.2.2.1 Road projects selection and prioritization practice for investment

No documents or records were found in the Authority to confirm the said selection as well as prioritization practice during interview. Though a lot of effort and time was exerted to find project's feasibility study reports and other relevant documents that could verify the road projects selection and prioritization practice in ORA, it could not be successful.

4.2.2.2 Practical use of road projectsprioritization practice for investment

As it was discussed in section 4.1.1.2 (ii), in this research, the ORA Road Network Study Report, the ORA GTP I Performance Report and reports on impact of URRAP projects were reviewed in order to verify the Authority's current prioritization practice; and the finding are described below.

i. ORA Road Network Master Plan Study

In order to evaluate and verify the Authority's road projects prioritization practice for investment and its effectiveness, it is found necessary to consider the ORA Road Network Study (performed in 2012) as a baseline. Hence, relevant sections of the study mainly; objectives and scopes including findings are summarized in the following section.

a. Objective of the Study

- General Objectives
  - ✓ The main objective the study was to update the regional network database and map, and develop a 20 years road network development master plan for the region.

- The specific objectives were to:
  - ✓ develop 20 years road network development plan of the region;
  - ✓ update and establish existing and future regional road network database system;
  - ✓ update and establish regional road network map;
  - ✓ establish rural road network ranking methodology,;
  - ✓ prepare Regional Environmental Guidelines; and
  - ✓ make maintenance need assessment on the existing and future roads expansion in the region and its vast investment options.

b. The scopes of the study

- Update the existing system and perform inventory of the existing road network;
- Develop a road network database and prepare regional road network map;
- Establish Rural Roads Priority ranking methodology and develop 20 years Regional Road Network Development Plan with Participation of the local community and administration.
- Develop Regional Environmental Guideline

c. Findings of the study

The construction of an adequate rural road network has become a center of national concern in Ethiopia, particularly in Oromia Region. It is seen as an essential infrastructure enabling the development of more than 80% of the population of the country as well as the Region. As mentioned above,ORA is entrusted with two major objectives of operations to achieve these goals, according to a consultant study. These include:

- Preservation of the existing network; and
- Increasing road network to address the goal of middle income nation target

Accordingly, the Consultant made evaluation and determination of the optimum size of the network targeting different regional and federal policies and strategies. The development plan for this particular study covers a program for the next 20 years i.e up to 2032 G.C. So the analysis extends beyond the GTP target of the coming 5 years. The optimum network size for the Oromia Region was evaluated based on three approaches (Random Model Approach, Graph Theory Approach and Square Grid Model Approach) and 60,145 km of new proposed roads, including URRAP roads were recommended and were used to prepare for the next 20 years plan.

In line with this and based on the scope of the study, the twenty years regional road network development plan addressed the following five areas:-

- Maintenance need program for 20 years;
- Upgrading existing gravel roads to paved roads;
- Upgrading Low Standard Access Roads;
- Incorporating Regional URRAP 5-years Program; and

- Planning major rural roads/arterial roads with DS3 standard to reach the intended sustainable development and vision to be middle-income country.

➢ Priority ranking methodology

The main aims of ranking the road projects in this study are to efficiently utilize: limited budgets, limited human resources, capacity and equipments and organize projects in systematic way for successful implementation with the target program period. The consultant focused on priority ranking for maintenance, upgrading of existing roads and implementation of new proposed roads. The methodology implemented for setting priority for ranking of road projects are categorized in to two as follows.

❖ Ranking for Maintenance or upgrading of existing gravel roads

If improving the road network is proved to be the best option to achieve sustainable transport service, it is obvious that the cost of restoring all roads at a time will be expensive. As a result, selection criteria must be applied to ensure that only those likely to be the most useful are improved. Accordingly, the ranking methodology applied for maintenance of road projects was the Core Planning Model (CPM) using selectivity index, which consider road condition, traffic, population, road importance for networking and connectivity and cost of maintenance or upgrading projects. The following were considered:

- **Existing Road Condition**: Roads, which are badly deteriorated get higher priority than roads in good condition if other parameters are constant.
- **Traffic**: Traffic is the other important parameter used for the ranking of road projects. Roads, which have high traffic, get higher priority. The value is represented by ADT.
- **Population Served by the link**: the population served by the link contributes a lot in priority ranking. The more population served the higher the priority.
- **Network Connectivity**:Importance of the link for the network and forming more coherent network. Important links get higher priority than those dead links, which contribute very less, in forming the regional network.
- **Cost**: cost is one of the parameter used for ranking. The higher the cost, the less

the road to be chosen for maintenance or construction since its cost can be used to maintain so many other roads which cost less with high importance vehicle operating cost savings (VOCSs).

- ❖ Ranking of New Proposed Roads and Upgrading Low Access Roads

The Ranking in this case is done using a combination of Core Planning Model-CPM and multi objective parameters, which contribute and play significant role in selection of roads. They are

- Road Density;
- Economic factors such as Tourism, Livestock;
- Availability of infrastructures; and
- Cost of construction.

ii. Impact of URRAP projects

According to the ERA GTP I Performance Report, 2007 EFY, Universal Rural Road Access Program (URRAP) was launched envisaging to connect all Kebeles by standard and affordable all-weather roads that provide year-round access. Within the program implementation period, it was planned to construct 71,523 km of all-weather roads throughout the country at an estimated cost of more than ETB 26.4 billion. The full-fledged implementation of URRAP was supposed to ensure year round access to road for about 80% of the total rural population in the country. The program is fully financed by the Government of Ethiopia.

It is also stated in the Report that, many Kebeles of the country were remained inaccessible by motorized transport and several areas inhabited by relatively large rural populations were isolated from the rest of the country. URRAP was launched for the mission of connecting all these rural kebeles throughout the country, 15,602 in total, by all weather roads at the end of 2014/15.

In connection with this, ERA has hired two consultants, which will capture baseline data and subsequently undertake impact assessment study on URRAP roads. For the purpose of this research only one consultant's report were reviewed that includes the impact of URRAP projects performed in Oromia region (Report for the Impact of

Rural Roads Constructed under URRAP in Oromia, Gambella, Harari Regions and Dire Dawa City Administration), and summarized hereunder.

a. Objectives of the study

The objective of the consultant's study was to track changes in basic welfare and outcome indicators selected and used during the baseline survey and to determine whether the indicators are progressing towards achieving the desired outcomes. The specific objectives are to assess and compile information on changes in agricultural production, tenure arrangements and demographic, economic conditions and trends, education, health, political structures, local participation and living conditions that might be influenced byroads constructed under URRAP. Furthermore, it explores changes in rural transportation, traffic flow, rural business productivity and changes in the flow of income and vehicles operating costs.

b. Findings of the study

The Consultant's survey elaborated the outcomes (intermediate and impact indicators) of these roads in the years since the program started. The changeswere analyzed based on the double differencing method that captures the attribution of roads from a number of development programmes and services operating in the area.

The Consultant selected and analyzed basic indicators under each sub topics; and compared changes, determined direction change (significance) and estimated magnitude of the influence. Specifically, the study answers three basic evaluation questions

1. Is there change (positive or negative)?
2. If so, is the change due to the road?
3. If yes, how significant is this change and what is the measured magnitude of change attributed to road?

Therefore, changes that are considered as best impact indicator of the roads (direct function of the road) were selected and summarized in Table 4.4 below.

Table 4.4:Impact of URRAP projects in Oromia Region

Item No.	Impact Indicators	*Mean Change (%)

1.	Land tenure arrangement – Size of contract out land (Ha) – Contract period for contracted out land (month) – Value of land contract out (Birr/Ha/month)	 +6 +36 +16
2.	Crop production – Crop production (Qt) – Crop sale (Qt)	 +66 +8.2
3.	Input utilization (fertilizer)	+33.7
Item No.	**Impact Indicators**	***Mean Change (%)**
4.	Livestock production – Proportion of household having animals	 +25
5.	Welfare indicators – Income change per household – Total expenditure per household – Durable asset possession	 +52.4 +21.2 +4.9
6.	Health Service – Proportion of mothers accessing assisted delivery service	 +19.4
7.	Education – School dropout	 -20.6
8.	Transport user survey – Frequency of travel – Modern transport user	 +170 +6.7
9.	Total vehicle operating cost	-80.6
10.	Traffic count (daily traffic flow) – Motorized – Non-motorized	 +46.8 +28.1
11.	Environmental impact (negative impact) – Loss of assets – Noises – Dusts – Flood	 +44 +60 +71 +54

*Mean change values are derived from sample baseline and actual survey

Source: 2nd year URRAP Impact Assessment Report

iii. Evaluation of ORA road network study objectives against impact of URRAP projects

It was observed in the summary of the ORA road network study that the study was conducted towards incorporating the Region's URRAP 5-years Program, in addition to planning major rural roads/arterial roads with DS3 standard to reach the intended sustainable development and with vision to be middle-income country and addressing other objectives. In this regard, ORA representative justification for not applying the ORA Road Network Master Plan Study in the Authority's current road projects prioritization practice for investment, "due to some government policy changes such

as URRAP (since most of the road network study objective can be addressed by this program)", is not consistent with the above review findings.

On the other hand, it is learnt from the report on impact of URRAP projects that URRAP was launched for the mission of connecting all rural kebeles throughout the country, 15,602 in total, by all weather roads at the end of 2014/15. In addition, Table 4.4 clearly show that the construction of URRAP roads have significant and desirable outcome in improving agricultural production, boosting rural business opportunities, income and welfare of the rural community. In this regard, the said URRAP projects' achievements could be considered as a positive indicator for the achievement of one of the two major objectives of ORA while conducting the regional road network master plan study (increasing road network to address the goal of middle-income nation target).

iv. Evaluation of ORA road projects rank against the road network study report (2012).

Based on the ORA GTP I performance report, some road projects under ORA which were commenced after 2012 (study of regional road network master plan) are listed and ranked according to their commencement date (projects that have early commencement date got prior rank) and were compared with its original rank presented on the Region's road network master plan study. Table 4.5below presents the same.

Table 4.5: Rank of road projects implemented/implementing by ORA after 2012

Project name	Implementation plan and rank as per ORA road network study	Actual year of commencement	Project rank as per road network study plan	Project rank as per the actual commencement date
Baradimtu – Bareedu	2012 - 2017 (16)	2012	3	1
Dubulluq-Dilloo	2012 - 2017 (25)	2012	4	1
BookeeXiqqo -Tayfee	2012 - 2017 (10)	2013	2	3
Galilaa - Waajjaa - Arqumbee-Gandaa 10	2012 - 2017 (29)	2013	6	3
Micata–Beeltuu	Not included	2014	7	5
Shaawwee- Angeetuu	2012 - 2017 (4)	2015	1	6
RiqaLagaArbaa(Calalaqaa-Matahaaraa)	2012 - 2017 (28)	2015	5	6

From table 4.5above, it is noted that the road that was given 1st priority is commenced at last and road that was not totally included in the 5 years plan (from 2012 to 2017) is commenced in the middle of the planned year (2014). The calculated correlation coefficient is 0.07 which explains no correlation between the two rankings.

In connection to this, the criteria that ORA has currently exercised which are mentioned during interview did not consider traffic count and the existing condition of the roads, whereas the other criteria are the same with the criteria considered in the road network study. This shows incompatibility of rankings between planned and actual implementation,one of the reasons being the failure to consider traffic count and existing condition of the roads in the actual ORA road selection and prioritization practice. Table 4.6below shows the criteria considered in the road network study against the criteria that ORA currently exercised.

Table 4.6: Road network study criteria vs. ORA actual practice

Item No.	Road network study criteria	Consideration in ORA actual practice
1	Road Density	Zonal road network
2	Economic factors such as Tourism, Livestock and Availability of infrastructures	Investment potential areas
3	Network Connectivity	Best road network
4	Population Served by the link	Population density
5	Traffic and Existing Road Condition	Would not be considered

4.2.2.3 Effectiveness ofroad projects selection and prioritization practice for investment

The encouraging impact of the newly constructed URRAP roads has been reflected on the improved accessibility situation of the rural population as the average hours households have to travel to get all weather road reduced from 3.7 hrs (11 km) in year 2010/11 to 1.7 hours (5.0 km) in 2014/15, according to the consultant's report on impact of URRAP projects.

In general, the consultant'sstudy found out that the construction of URRAP roads have significant and desirable outcome in improving agricultural production, boosting rural business opportunities, income and welfare of the rural community. However,

the consultant has found some gaps on effectiveness of URRAP projects, described as follows.

- Environmental considerations during the design and construction of the roads are necessary to reduce maintenance costs and increase service years. It was also observed from Table 4.4that the impact of URRAP projects attributed significant negative impactson the environment such as: noise, dust, and flood.
- The adoption of compensation and safeguard policies should also be in place to ensure sustainability and reduce conflict between the programs and the affected population.
- Some of these roads are of poor design and quality and hence could not provide the desired level of services.
- There are also lagging of construction activities, which may extend beyond 2017 (period of end line evaluation).
- Given the increasing traffic flow on most of these roads, upgrading and rehabilitation activities are critical.

On the other hand, in order to verify effectiveness of the ORA road projects selection and prioritization practice for investment (for capital projects exclusive of URRAP projects),a questionnaire was developed and distributedto potential interviewees and desk study was performed on the selected two projects as part of case study; and its findings arepresented in section 4.3 (case study).

4.3 Case Study

The 2nd research question was "what are the challenges and gaps of the current road projects investment prioritization practice in Ethiopia?" In order to obtain answer for this question, a case study was conducted on completed and ongoing projects selected as one of the tools. Accordingly, four projects were selected as part of the case study to assess the road users and stakeholders' opinions that demonstrate the relevance and effectiveness of the current road projects investment prioritization practice in Ethiopia.

In order to assess the road projects effectiveness in Ethiopia, a questionnaire was developed and distributed to road users and stakeholders on the selected sample road

projects. In addition, a desk study was conducted on selected case study projects as to support and strengthens the questionnaire findings.

4.3.1 Questionnaire findings

4.3.1.1 Introduction

This section provides explanations to the issues related to distribution of the questionnaire, collection of responses and composition of the respondents. The principal purpose is to rate and rank indicators of road projects effectiveness and to identify critical indicators in order to find out the gaps regarding the Ethiopian road projects selection and prioritization practices that are required for due attention in order to improve the current selection and prioritization practice. One of the major difficulties of road evaluation is to obtain consistent and reliable indicators that can measure the impact of road construction and rehabilitation projects. Impact of road is trans-boundary and affecting many sectors and population groups. Its impact is therefore cross-sectoral which can complicate impact evaluation.

On the other hand, even if proper experimental design was used spillover effect of road is high. Furthermore, road construction alone is not the only contributor of change. In order to evaluate roads' contribution to certain desired changes for example education, health, extension services; these services should be available in the area in the first place. Furthermore, competitive transportation service should accompany construction, for the road to have a positive impact on welfare.

Hence,the questionnaire was developed covering the two important parameters: selection and prioritization of projects and its implementation. Accordingly, it was distributed to different road users and stakeholders in order to assess their opinions and the responded questionnaires were collected through personal delivery method with immediate collection of completed questionnaires. The participants of the study were zonal roads authorities, woreda administrative offices, direct road users and different project stakeholders.

Accordingly, five Zonal Roads Authorities in Oromia and Amhara regions were selected with their offices located around Addis Ababa and these were: East Shewa Zone (Adama), West Shewa Zone (Ambo), South-West Shewa Zone (Wolisso), North

Shewa Zone (Debrebrhan and Fiche). In addition, a minimum of one woreda was included in the questionnaire for each project.

Furthermore, to collect comprehensive and demonstrative data, persons with differentprofessional disciplines, age and job were involved in the questionnaire. Since the participants were at different level of educational background, the questionnairewas translated in to their respective local languages, and in some cases, the responses to the questionnaireswere performed through interviewing process.

4.3.1.2 Questionnaire response compilation and rating

A total of 105 questionnaires were distributed to the selected sample of potential respondents that is; 25 samples from each project and 5 samplesfrom the zonal road authorities'representatives. Since the questionnaire was distributed and collected through personal delivery method followed with immediate collection of completed questionnaire, all of the distributed questionnaires were collected and used in the analysis of the data. The details of the respondents' composition, questionnaire distribution and collected percentages are shownin Table 4.7 below and subsequently, Figure 4.1 illustrates the number of distributed questionnaires, responses, compositions and ratings.

Table 4.7:Respondent composition, questionnaire distribution and collected percentages

Item No.	Respondent	Total Questionnaire Distributed, No.	Total Questionnaire Collected, No.	Response rate (%)
1	Zonal road authorities representatives	5	5	100.0
2	Woreda transport office representatives	4	4	100.0
3	Woredaadministrative offices representatives	9	9	100.0
4	Business men	15	15	100.0
5	Police officers	7	7	100.0
6	Drivers	14	14	100.0
7	School Directors & Teachers	9	9	100.0
8	Health Officers	4	4	100.0
9	Farmers	27	27	100.0
10	Housewives & others	11	11	100.0
Total		**105**	**105**	**100.0**

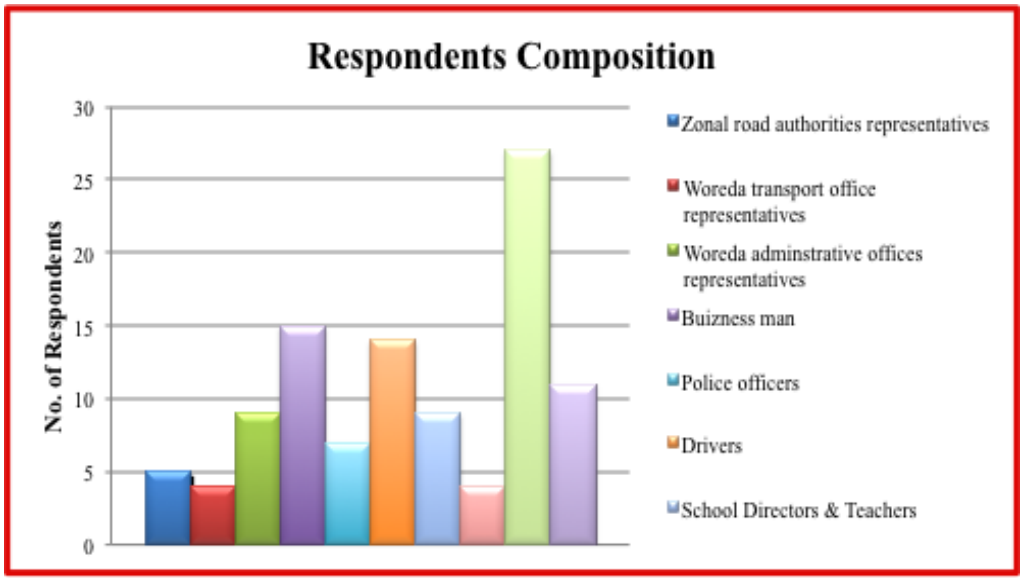

Figure 4.1: Questionnaire Response Compositions and Rating

4.3.1.3 Structural Arrangement of Questionnaires

Since the research area was very wide that need to be structured, and respondents are also required to be flexible in responding some of the questions, a semi-structured questionnaire was used in the study. The questionnairewas also carefully designed in light of getting a high response rate from the participants. In this respect, a preliminary questionnairewas distributed to five selected respondents and the substance of questionnaire was tested. In due course, the questionnaire was modified incorporating the comments obtained from the preliminary test.

The main body of the questionnaire was fundamentally formulated in the order of itsappearance in road project planning discipline in respect of project selection then prioritization and next implementation (See table 4.8). Finally, general questions were incorporated to identify the attitudes of respondents on the overall matters. Table 4.8 belowshows the structural arrangement of the questionnaire.

Table 4.8: Structural Arrangement of the Questionnaire

Parameters	**Impacts**	**Indicator**
Selection and	Community's involvement	- Public consultation in identification of road projects.

Parameters	**Impacts**	**Indicator**
Prioritization practice		- Consideration of public interest in selection of road projects.
	Importance of the road	- Consistency with the local people need/interest. - Provision of intermodal accesses. - Connectivity with the overall transportation network. - Level of passenger cars and trucks freight movement. - Impact on growth of community's livelihood.
	Degree of the constructed roads to support the community's livelihood support	- Improvement of crop production and provision of easy market access. - Support in facilitating trade market within the road influence area. - Provision of access to school, health center and other services. - Improvement of zonal and regional connectivity.
	Improvement in use of transportation within the community	- Availability of transport vehicles. - Change in transportation costs in favor of users. - Change in travel time. - Rate of accident reduction.
	Accident rate	- Provision of safety and other facilities for pedestrians. - Quality of the constructed roads. - Sufficiency rate of routine and periodic maintenance or rehabilitation costs. - Awareness on the road users.
	Impact on social and environment	- Flood - Landslide - Cutting of trees and cultural heritage damage - Change of settlement on large group of community.
Implementation practice	Quality of the constructed roads	- International Roughness Index (IRI) by road surface type.
	Maintenance practice	- Road serviceability for design life.

Parameters	Impacts	Indicator
	Degree of compensation and affected groups level of satisfaction	- Rate of maintenance intervention. - Property compensation rate.

The alternative answers for the structured part of the questionnaire were developed based on Likert's-scale of three ordinal measures of agreement or disagreement (from 1 to 3) towards each statement indicating its favorableness or otherwise. Measures of agreements are as follows:

- Significantly, S
- Partially, P
- Not at all, N

The percentage of respondents was also calculated to understand the frequency rate.

4.3.1.4 Analysisof Questionnaire

In the data analysis, the 'Mean Score (MS)' is adopted to evaluate the respondents' attitude. As discussed earlier, Likert's Scale of three ordinal measures of agreement in respect of each statement (1, 2, 3) was used to calculate the MS of each indicators stated under the corresponding questionnaire categories. The MS of each variable is, then, computed using the Equation 3.1cited in the methodology section. In the subsequent sections; analysis, findings and discussion are presented.The detail computation is attached in Appendix 4.

4.3.1.5 Road projects selection and prioritization practice for investment

i. Public Consultation

Two questions are developed in the questionnaire as to assess the roads authorities public consultation practice and the given response analysis is summarized in Table 4.9 below;

Table 4.9: Summary of results on public consultation process

Questions	Projects designations	Total No. of Respondent	Mean Score	Percentage	Attribute

Do the road agencies consult the public while identifying the road projects?	ERA road projects	55	1.25	31.25	N
	ORA road projects	50	1.44	36	N
Do the road agencies use any mechanism to convey the public interest regarding the road network to the roads authority or to respective offices?	ERA road projects	55	1.4	35	N
	ORA road projects	50	1.08	27	N

The result shown above revealed that there is less public consultation practice in the roads authorities and also less consideration of the public interest in decision-making process with less impact. The respondents forward their suggestion in this regard as described below;

- The roads authorities must improve public consultation practice before selecting the project and commence construction.
- Public consultation must be done directly with the community not through representatives.

ii. Importance of the roads

Most of the respondent involved in both ERA and ORA road projects expressed their agreements on the importance of the constructed/serviceable roads, as detailed in Table 4.10below.

Table 4.10: Summary of the results on the importance of the constructed/serviceable roads

Questions	**Projects designations**	**Total No. of Respondent**	**Mean Score**	**Percentage**	**Attribute**
Do the road agencies consult the public while identifying the road projects?	ERA road projects	55	2.42	60.5	P
	ORA road projects	49	2.82	70.5	S

Some of the respondents who did not agree on the significance of the road have expressedtheir opinion regarding possible reasons as indicated in Table 4.11.

Table 4.11: Rank of factors that reduce importance of the roads

Attributes	Rank on ERA project	Rank on ORA project
Inconsistent with the local people need/interest	2	1
Do not provide intermodal accesses	4	4
Lack of connectivity with the overall transportation network	2	3
Lack of passenger cars and trucks	5	5
Do not promote tangible and sustainable growth on the community's livelihood	1	1

Ranking ERA and ORA in respect of attributes is highly correlated with a coefficient value of 0.92.

From the results shown in Table 4.11 above, it has been observed that, not resulting tangible and sustainable growth on the community's livelihood, inconsistency with the local people need/interest and poor connectivity with the overall transportation network are the major factors that reduce the importance of case study road projects.

iii. Degree of the constructed roads in supporting the community's livelihood

The respondent's reaction in relation to the degree of the constructed roads in supporting the community's livelihoodis presented in the following Table 4.12.

Table 4.12: Summary of results on the degree of the constructed roads in supporting the community's livelihood

Questions	Projects designations	Total No. of Respondent	Mean Score	Percentage	Attribute
How many of the constructed roads support the community's livelihood?	ERA road projects	55	2.38	59.5	P
	ORA road projects	48	2.48	62	P

As shown in Table 4.12 above, most of the respondents involved in both ERA and ORA road projects expressed their agreements on the road projects significance in support the communities' livelihood.

Respondents who agreed on the roads' significanceimpact in supporting the communities' livelihood have expressed their opinionregarding the attributes as indicated in Table 4.13.

Table 4.13: Ranking of factors that improve the roads impact in supporting the communities' livelihood.

Attributes	Rank on ERA project	Rank on ORA project
Increase crop production and provide easy market access to the community	1	1
Facilitate and support trade market within the road influence	3	3
Increase access to school, health center and other services	2	2
Increase zonal and regional connectivity	4	3

Corelation coefficient of ranking was calculated at 0.94 which is very strong.

As shown in Table 4.13above, the roads impact towards improving the communities' livelihood by increasing crop production and provide easy market access and increasing access to school, health center and other services got priority rank. On the other hand, the roads impact especially ORA roads in improving zonal and regional connectivity was ranked least.

iv. Improvements in use of transportation provisions within the community

As per the result shown in Table 4.14 below, the ERA road projects considered in the case study showed lower impact than the ORA road projects regarding improvement of transportation provision within the community.

Table 4.14: Summary of the results on impact of the constructed roads towards improving use of transportation provisions within the community

Questions	Projects designations	Total No. of Respondent	Mean Score	Percentage	Attribute
Do the constructed roads improve the use of transportation within the community?	On ERA road projects	55	2.31	57.7	P
	On ORA road projects	50	2.64	66	S

Respondents were requested to express their opinion on the possible factors that improve the community's transportation practice and the resultsare shown in Table 4.15 below.

Table 4.15: Rank of factors that improve use of transportation within the communities

Description of Factors	ERA road projects		ORA road projects	
	Mean Score	Rank	Mean Score	Rank
Sufficiency of transport vehicles	1.51	2	1.72	2
Reduced transportation cost	1.24	3	1.20	3
Reduced travel time	2.78	1	2.88	1
Reduced accident rate	1.00	4	1.00	4

From Table 4.15 above, it can be observed that all ERA and ORA case study road projects have significant impact towards reducing travel time in order to improve the use of transportation provisions within the community. However, the major factor that causes the reduction of ERA road projects impact in improving use of transportation provisions within the community is significant negative impact of the constructed roads in reducing accident rate.

v. Accident rate

Respondents involved in both ERA and ORA road projects expressed their disagreements with the reduced accident rate, with a mean square value of 1 (100%, not reduced at all). The result shows, that there are factors that the problems related with.

Respondents who perceive that, the accident rate has increased due to newly constructed roads have indicated the cause of accidents as shows in Table 4.16 below.

Table 4.16: Ranks of factors that cause road accidents under ERA and ORA projects

Description of Factors	Rank on ERA project	Rank on ORA project
Lack provision of safety and other facilities for pedestrian	2	1

Description of Factors	Rank on ERA project	Rank on ORA project
Poor quality of the constructed road	3	2
Lack of routine and periodic maintenance or rehabilitation	4	4
Lack of awareness on the road user	1	3

From the results shown in Table 4.16above, lack of awareness on the road users, lack of provision of safety and other facilities for pedestrian and poor quality of the constructed roads got higher rank for being cause of accident. However the ranking are poorly correlated with a coefficient of 0.4.

vi.Social and Environmental impact of the roads

Aquestionwas formulated to assess the roads impact on social and environment and the responses as analyzed are summarized in Table 4.17 below;

Table 4.17: Summary of results on Social and Environmental impact of the constructed roads

Questions	Projects designations	Total No. of Respondent	Mean Score	Percentage	Attribute
Do the constructed road affects social or environmental patterns of the project areas?	ERA road projects	53	2.51	62.7	S
	ORA road projects	49	2.51	62.7	S

As shown in Table 4.17above, most of the respondents involved in both ERA and ORA road projects expressed their agreements on significant negative social and environmental impacts of the road projects under the case study.

Respondents who agree on the roads negative social and environmental impact have expressed their reactionsin respect of the attributes as depicted in Table 4.18 below.

Table 4.18: Rank of factors that affect social and environment

Description of Factors	Rank on ERA project	Rank on ORA project
Cause of flood	2	1

Cause of landslide	3	4
Cause of cutting huge amount of trees and cultural heritage	4	3
Cause of resettlement for a large group of peoples	1	2

The calculated correlation coefficient regarding ranking between ERA and ORA in respect of social and environment is 0.6 which is relativelly significant.

As shown in Table 4.18above, the major factors that caused significant negetive impact onsocial and environment are flood and resettlement of large group of peoples that resulted due to newly constructed roads.

4.3.1.6 Implementation practice

It was mentioned under the literature review that the implementation practice has significant impact on the success of road projects planning. Accordingly, questions were included under this section of questionnaire with the aim of checking the implementation parameters identified in the literature survey in connection with the practicality of planning.

The respondent's reaction in relation to the implementation practice is presented in the Table 4.19 below.

Table 4.19: Mean score of implementation practice parameters

Implementation parameters	ERA road projects		ORA road projects	
	Mean Score	**Attribute**	**Mean Score**	**Attribute**
Quality of the constructed roads	1.34	N	1.32	N
Maintenance of the roads	1.10	N	1.04	N
Degree of compensation and affected groups level of satisfaction	1.65	P	1.58	P

From Table 4.19 above, it is observed that the implementation parameters do not improve impact of the roads in positive way; especially, maintenance of the roads got least MS value that shows there is poor maintenance practice.

Respondents, who perceive that the constructed roads did not fulfill the desired quality, have mentioned their reasons as detailed below;

- Drainage and other pedestrian facilities are not constructed well;

- The roads do not provide proper pedestrian access and crossings;
- Protection works for people living nearby high fill area and cut section is not properly constructed;
- Poor quality of pavement structure (potholes and rough surface finishing is common to see on the newly constructed road projects);
- Overflow of water from the ditches would be observed; and
- The roads are easily damaged by flood.

4.3.1.7 Suggestions as measures to improve the selection and prioritization of road projects

At the end of the questionnaire, respondents were requested to express their comments and suggestions on the overall practice of selection and prioritization of road projects to improve the road identification and prioritization processes in the future. Accordingly, participants pointed out their comments, suggestions and expectations from the roads authorities summarized as follows.

i. Comments and suggestions given on ERA road projects

- The roads authority should improve public involvement practice in decision-making process towards selection and prioritization of road projects.
- Road project studies should incorporate social and environmental protection activities.
- ERA and ORA should involve all stakeholders in the route selection and construction process.
- ERA and ORAshould improve quality of the road construction and maintenance practice.
- Clear and proper compensation process should be in place and addressed to the public.
- The road projects route selection and design process should properly consider the habitats settlement patter.
- The road design process should consider actual terrain condition of the project area.
- The roads authority safety practice should be improved.
- Delay in construction of road projects should be reduced.

- The route selection process should consider connectivity of different woredas/villages along the route.

ii. Comments and suggestions given on ORA road projects

- Safety of the roads must be considered such as pedestrian facilities during design.
- The road standard and road network should consider the actual population density and traffic growth.
- Consultation practice with public should be improved from selection to end of construction.
- Quality of the roads must be improved.
- Timely maintenance and upgrading of the roads should be performed according to traffic volume and condition of the road.
- Social and environmental impact of the roads must be minimized.

4.3.2 Desk study findings on case study projects

4.3.2.1 Desk study on selected projects

Investigations were made through desk study on selected projects for case study. The findings of the desk study is presented under the following sections. The data and information taken regarding each project were: design document, progress report, completion report, and Consultant's social and environmental impact assessment report. Tables 4.20 to 4.23 below present the results of the desk study under project ID No. 1 to 4 respectively.

Table 4.20: Desk Study, Project ID No 1

Desk Study: Project ID No 1		
I/ No	**Indicators**	**Observation**
1	Socio-Economic Characteristics and Land use pattern	• The major economic activities being practiced in and around the project area includes mixed agriculture (crop production and animal husbandry) traditionally managed by small holders' households, commercial farming, pumice and lime quarry sites and sand mining.
		• The original design standard of the road was changed from DS4 to DS3 & DS2 (from DBST to AC), as per ERA 2002 Road Classification.The given justification for such design standard change was the expected diverted traffic from other routes. However, it is observed during site visit of the project while collecting questionnaire that there is no significant traffic flow in the project road as it is assumed in the traffic data analysis report. In addition, there is an

Desk Study: Project ID No 1		
I/ No	**Indicators**	**Observation**
2	Road design standard	expressway and other existing main road parallel to the project route that can possibly reduce the expected diverted traffic amount significantly.
3	Safety of the road	• The safety activities is performed only for construction period such as the provision of traffic signs, provision of flag men/women etc, however local residents and domestic animals are at risk due to accidental falling of detached rocks or boulders or sliding of loose materials disturbed during cutting in steep slopes. • Safety provision was not observed related with road users safety in review of design document, project progress & completion reports. However, it was observed in the progress report that since pumice and lime quarry sites and sand mining activities were performed in the project area, significant number of truck movements are expected that causes accident.
4	Environmental and Social Impact of the road	• The project road disfigure the natural environment unnecessarily and jeopardize the health of the communities living nearby those sites. • The quarry site users didn't rehabilitate the abandoned site and mitigate impacts they are imparting to the local residents and employees.
5	Right of way issues (Resettlement action)	• The project route corridor is traversing through fertile lands and the occupied significant land area both for the road carriageway and for ancillary works such as for detour roads construction and sites for spoil soils disposal, campsite, transportation and haulage of construction material and traffic management, etc. • Moreover, construction activities create an obstruction to the movement of people and animals. It is learnt from the report that the local communities land use pattern is significantly affected by construction of such road.
6	Sustainability of the road (quality of the road and maintenance requirement)	• It is observed from project progress report that the Contractor was repeatedly instructed by the Employer's representative to solve the problem encountered on quality of asphalt pavement.
7	Cost and duration of the project	• As the project is design and build, no variation and substantial cost inflation was observed. • The project was completed after 2 and half years of construction period plus additional 180 calendar days.

Table 4.21: Desk Study, Project ID No 2

Desk Study: Project ID No 2		
I/No	**Indicators**	**Observation**
1	Socio-Economic Characteristics and Land use pattern	• Most areas of the project corridor are suitable for agriculture and intensive farming lands are in harvesting crops.
	Road design standard	• The road is constructed with a standard of triple surface

Desk Study: Project ID No 2		
I/No	**Indicators**	**Observation**
2		treatment
3	Safety of the road	• During construction stage, condition survey of each horizontal curve, vertical grades, vertical curves were collected and analyzed. Accordingly Sight distance for stopping and passing both for vertical and horizontal curves, road markings, provisions of guardrail posts and the required traffic signs of entire project were checked. However, no activities were observed with regard to pedestrian walkway in the town section except inclusion of ditch cover for paved ditch within the town section though it is constructed with poor quality (as per the project progress report)
4	Environmental and Social Impact of the road	• There are a number of completely utilized borrow and quarry sources, detour roads and spoil areas, which requires the Contractor's prompt action to reduce the impact on the community. • Soils are highly expansive which exhibit large volumetric changes due to swell when soaked in water and shrink and crack when they become dry, that caused flood and landslide.
5	Right of way issues (Resettlement action)	• Significant area of the farmland is occupied by the road construction activities such as detour construction, roadway, etc.
6	Sustainability of the road (quality of the road and maintenance requirement)	• Failure was observed in proper execution of reinforced concrete drain and pavement layer.
7	Cost and duration of the project	• 3 years construction period and additional 2556 calendar days were elapsed at 89% of project progress, and there is a deviation in contract amount due to design modification on vertical and horizontal alignment to avoid excessive fill section.

Table 4.22: Desk Study, Project ID No 3

Desk Study: Project ID No 3		
I/No	**Indicators**	**Observation**
1	Socio-Economic Characteristics and Land use pattern	• Land in the project area is covered by farming lands, coffee plantations, and short stretches of dense forest. • Most of the land along the alignment is cultivated.
2	Road design standard	• The project was a new road of 36km long with a gravel-wearing course and the standard of the road is DS6, as per ERA 2002 Road Classification.
3	Safety of the road	• Road safety during construction was performed such as traffic signs and deployment of enough flag persons. • Proper traffic signs, guideposts and guardrails should have been provided to enhance road safety after completion of the road.

Desk Study: Project ID No 3		
I/No	**Indicators**	**Observation**
4	Environmental and Social Impact of the road	• Potential soil erosion takes place during construction operations due to mining of construction material from hill slopes and during post construction in cut slopes, high embankments and outlets of cross-drainage structures. • The contractor has carried out reinstatement of all quarry sites. • There was removal of number of trees due to construction of new road and sourcing of borrow sites and the overall impact of tree cutting on the environment was negative in terms of long term effects on climate of the area as a whole, reduced aesthetics, reduces stability of slopes and increased erosion.
5	Right of way issues (Resettlement action)	• The project alignment is a new route, which traverses various lands of different uses. In addition, the project affects the urban settlement areas along the project road, four towns.
6	Sustainability of the road (quality of the road and maintenance requirement)	• Deficiencies were observed in performing protection works towards minimizing the impacts of flood and landslide.
7	Cost and duration of the project	• The project is completed after 2 years contract period plus additional 595 calendar days. • The project is completed with ETB 203,025,632.20 of original contract price plus ETB 49,268,755.73 variation.

Table 4.23: Desk Study, Project ID No 4

Desk Study: Project ID No 4		
I/No	**Indicators**	**Observation**
1	Socio-Economic Characteristics and Land use pattern	• Socio-economic development of the area is trade and agriculture.
2	Road design standard	• Upgrading of 38.38km natural gravel surfaced road to DS6 standard
3	Safety of the road	• Safety related issues was not observed in all of the collected documents during this desk study, however it is observed in the design document that the road is designed with 6m width and no provision was observed regarding pedestrian safety.
4	Environmental and Social Impact of the road	• Farms and public properties were damaged by flooding due to siltation of the roadside and cross drains. • The dusts created around borrow pits poses health hazards to workers in quarry sites. In addition, the dust produced around construction areas and diversions put the road users and nearby dwellers to inconvenience and causes visibility problems.
5	Right of way issues (Resettlement action)	• There was ROW problem in town sections on residential houses and public properties, and resulted resettlement of large numbers of inhabitants.
6	Sustainability of the road (quality of the road and maintenance requirement)	• Problems were observed on minor drainage structures such as overtopping and silting.

Desk Study: Project ID No 4		
I/No	**Indicators**	**Observation**
7	Cost and duration of the project	• The project is completed after 3 years contract period plus additional 276 calendar days. • The project is completed with ETB 212,238,256.00 of original contract price plus ETB 1,087,736.84 variation.

4.3.2.2 Summary of the observations from the desk study

Summary of observations obtained from desk study is presented below in respect of each indicator;

i. Socio-Economic characteristics of the road and land use pattern

The case study road projects regarding socio-economic characterstics is mainly agriculture and intensive farming lands are under crops and other farming activities.

ii. Road design standard and safety of the road

According to the ERA Design Manaual of 2002, for roads with the design standard from DS1 to DS6, at least 2.5m footway width in the town section is required; whereas, for DS6 standard roads parking lanes requirement is open which is expected to be provided where urbanization requires this facility.

Furthermore, it was noted from the desk study on the casestudy road projects (with the road standard between DS1 and DS6) that the safety of the road users did not give due attention although safety issues was the major concern during construction and post construction stage. Some of the observed problems with regard to safety were pedestrian acces and crossings and lack of protection works for flood and landslide.

iii. Social and Environmental Impact of the road

Social and Environmental impacts of the roads considered in the case study were significant that were caused by construction activities. Besides, it was observed that the constructed roads resulted in permanent negative impacts in respect of social and environmental patterns by affecting dense forests, settlement patterns of societies, occupying significant area of farmlands by construction activities. Some of the impacts were caused due to poor implementation practices regarding social and environmental management plan and the remaining were due to lack of proper consideration of social and environmental impact of the roads at the planning stage.

iv. Right of way issues (Resettlement actions)

It was observed from desk study that the local communities land use patterns were significantly affected due to construction of the project roads under the case study.

v. Sustainability of the road

The quality of casestudy road projects was not satisfactory due to poor design quality and contractors' performances. Similarly, some of the observed quality problems were:poor quality of pavement structure, failure in performing protection works for floods and landslides, and overtopping and silting problems on minor drainage structures.

vi. Cost and duration of the project

Significant delay in completion of road construction was observed regrding the casestudy projects. However, changes were not observed in project costs except on one case study road project (24.2% cost increment of the original contract price).

4.3.3 Gaps identified in the case study ofERA and ORA road projects selection and prioritization practices for investment

From the analysis of the responses of the questionnaire and desk study made on selected case study projects, critical impact indicators were assessed and the gaps were identified. Table 4.24 and 4.25below shows summary of the Mean Score and rank of impact indicators on ERA and ORA projects respectively. Subsequently, Figure 4.2 and 4.3 presents the MS of impact indicators and impact indicators frequency of the ERA road projects respectively; and Figure 4.4 and 4.5 presents the MS of impact indicators and impact indicators frequency of the ORA road projects respectively.

Table 4.24: Summary of Mean Score and Rank of impact indicators on ERA projects

I/No	Question No.	Impact Indicators of the Project Road	Mean Score	Rank	Percentage	Attribute
	i.	**Selection and Prioritization parameters**				
1	2.2	Public Consultation	1.25	4.00	41.82	N
2	2.6	Importance of the roads	2.42	1.00	80.61	P

I/No	Question No.	Impact Indicators of the Project Road	Mean Score	Rank	Percentage	Attribute
3	2.8	Degree of the constructed roads to support the community's livelihood	2.38	2.00	79.39	P
4	2.10	Improvement in use of transportation within the community	2.31	3.00	76.97	P
5	2.11	Reduced accident rate	1.00	5.00	33.33	N
	ii.	**Implementation parameters**				
6	2.13	Quality of the constructed roads	1.34	2.00	44.65	N
7	2.15	Maintenance of the roads	1.10	3.00	36.60	N
8	2.16	Degree of compensation and affected groups level of satisfaction	1.65	1.00	54.94	P
		Negative Impact				
9	2.17	Impact on social and environment	2.51	1.00	83.65	S

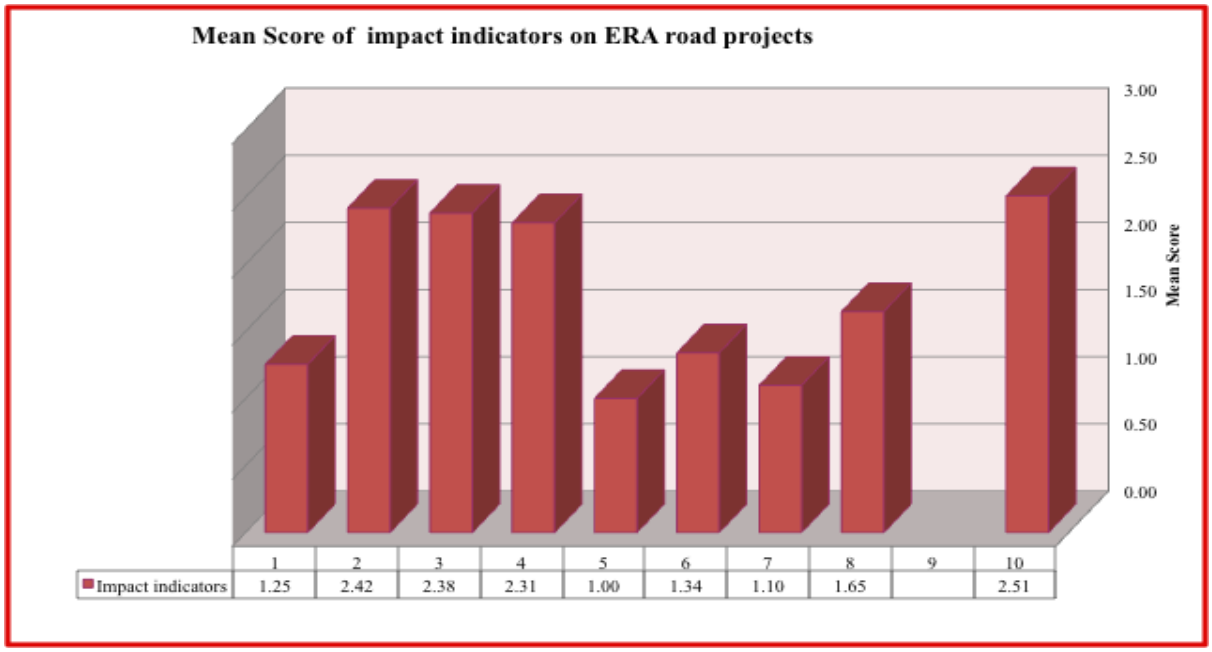

Figure 4.2: Mean Score of impact indicators on ERA projects

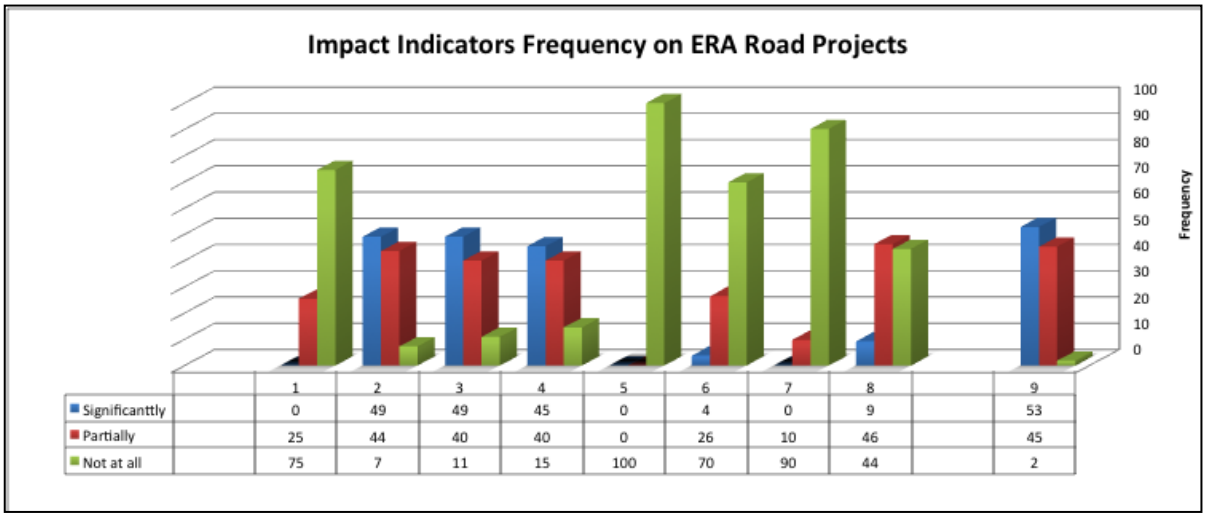

Figure 4.3: Impact indicators frequency on ERA road projects

Table 4.25: Summary of Mean Score and Rank of impact indicators on ORA projects

I/No	Question No.	Impact Indicators of the Project Road	Mean Score	Rank	Percentage	Attribute
	i.	**Selection and Prioritization parameters**				
1	2.2	Public Consultation	1.44	4.00	48.00	N
2	2.6	Importance of the roads	2.82	1.00	93.88	S
3	2.8	Degree of the constructed roads to support the community's livelihood	2.48	3.00	82.64	P
4	2.10	Improvement in use of transportation within the community	2.64	2.00	88.00	S
5	2.11	Reduced accident rate	1.00	5.00	33.33	N
	ii.	**Implementation parameters**				
6	2.13	Quality of the constructed roads	1.32	2.00	44.00	N
7	2.15	Maintenance of the roads	1.04	3.00	34.67	N
8	2.16	Degree of compensation and affected groups level of satisfaction	1.58	1.00	52.67	P
		Negative Impact				
9	2.17	Impact on social and environment	2.51	1.00	83.67	S

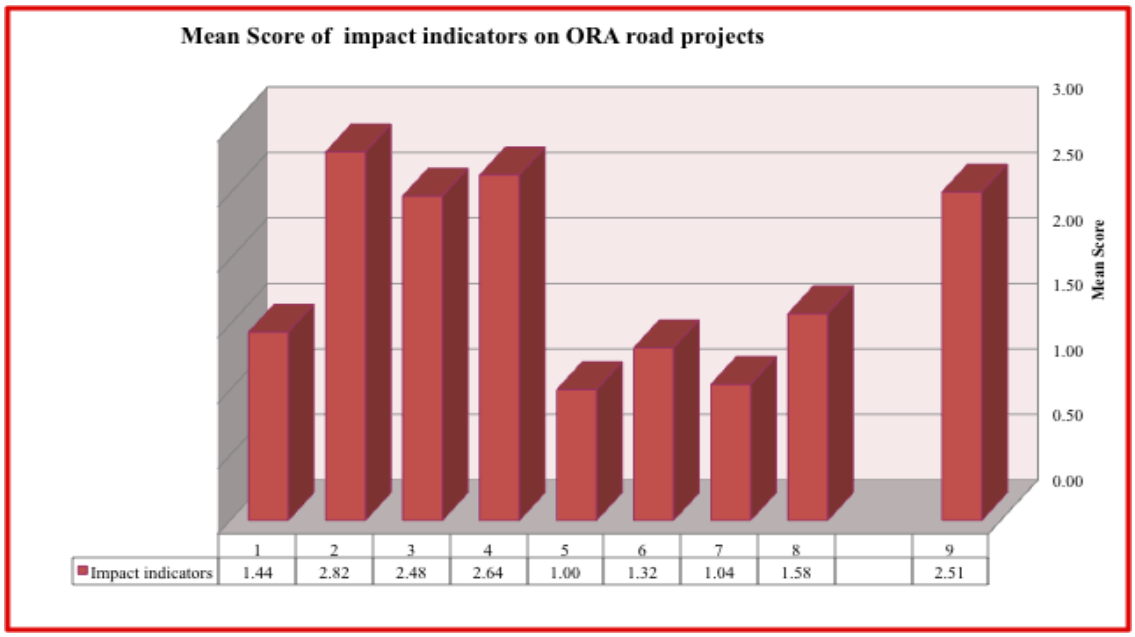

Figure 4.4: Mean Score of impact indicators on ORA road projects

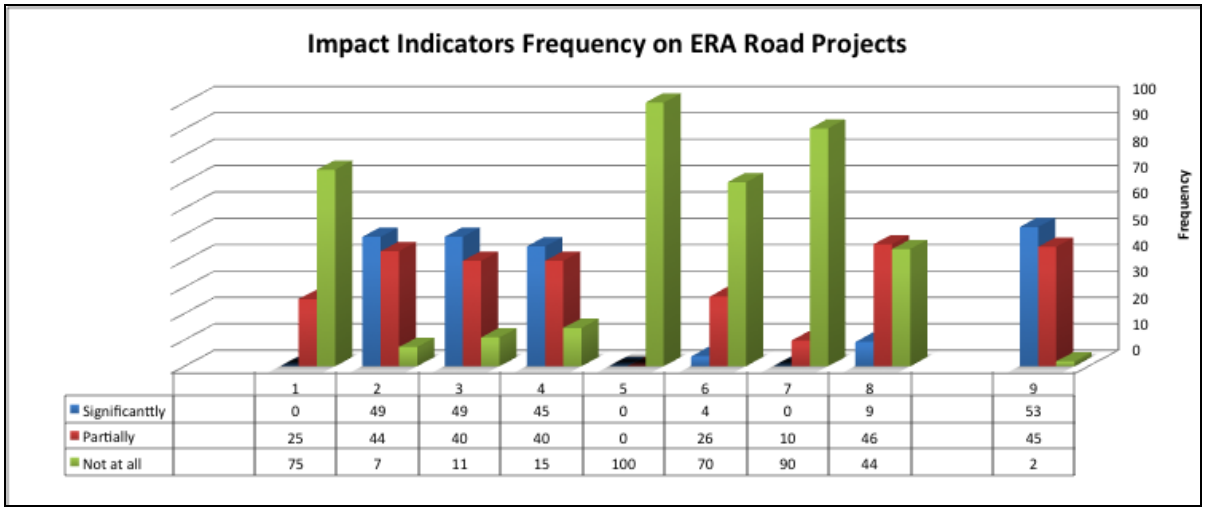

Figure 4.5: Impact indicators frequency on ORA road projects

4.3.3.1 Gaps on selection and prioritization parameters

Based on the results as shown in Table 4.24 and 4.25 above, the parameters considered for road selection and prioritization practice, public consultation and reduced accident rate have a scale of 1.25 and 1 on ERA projects and 1.44 and 1 on ORA projects respectively. Theseresults show that the roads had very low degree of impacts on these parameters according to AbdMajid&McCaffer, (1997). In addition, social and environment impact of the roads has a MS value of 2.51 on both ERA and ORA projects, which shows that the roads had higher degree of negative impact on

social and environment. It was also observed from Figure 4.2that the MS in case of ERA road projects is even greater than importance of the roads in respect of social and environmental impact of the roads.

All of these identified parameters have significant negative impact and lower positive impact according to the respondents and therefore, they are considered as critical indicators of the selected case study road projects effectivness which needs improvement action.

It was also learnt from desk study observation that all the roads under case study did not have sufficient safety provisions to reduce the accident rates caused as the result of the constructed roads. In addition, the social and environmental impacts of the roads were significant due to lack of giving enough attention during feasibility study and also due to failure of the Contractors in implimenting social and environmental management plan.

Moreover on ERA projects, impacts of the roads towards improving the use of transportation within the community has lower scale of 2.31 as compared to the score observed on importance of the roads and degree of the constructed roads to support the communities' livelihood, 2.42 and 2.38. Whereas, on ORA projects, impact of the roads towards supporting the community livelihood has lower scale of 2.48 as compared to importance of the roads and improvement in use of transportation services within the community, 2.82 and 2.64 respectively.

As per the analysis results shown in Section 4.3.1.5 (iv), the major factor that minimizes the improvement of communities' transportation practices was higher rate of accident resulted from the construction of the roads. From desk study, it was also observed that the selected case study projects from the ERA lack enough safety provision and due attention was not given during design and construction of the roads.

Impact of ORA roads towards supporting the communities' livelihoods was reduced because the selected case study road projects did not give much improvement for zonal and regional connectivity, according to the results stated in section 4.3.1.5 (iii), However, accordinng to Lebo and Schelling, World Bank (2001), the role of low-volume roads (rural roads) is ensuring basic access to resources and opportunities

rather than regional connectivity. In this regard, the questionnaire findings showed that the ORA roads have significant impact towards improving the communities' livelihoods by increasing crop production and provide easy market access and increasing access to schools, health centers and other services. Besides, it is expected that zonal and regional connectivities would be improved through federal road projects rather than rural road projects, and hence it is not necessary to consider "the reduced impact in supporting the communities' livelihoods due to lack of zonal and regional connectivity" as a gap.

4.3.3.2 Gaps on implementation parameters

In the implementation parameters;maintenance practice, quality of the roads, degree of compensation and affected groups level of satisfaction have a mean score value of 1.1, 1.34 and 1.65 respectively on ERA projects and 1.04, 1.32 and 1.58 respectively on ORA projects. All implementation parameters, especially maintenance practice had lower positive impact on the selected case study road projects effectiveness. According to ERA maintenance specification manual, all maintenance activities have to be carried out at least once per year through routine maintenance. Such activities include inspections, cleaning of drains, controlling of vegetation's, filling of potholes and ruts, etc. On the other hand, periodic maintenance intervals depend to a large extent on the quality of the construction.

In this regard, it is observed from desk study that all road projects considered in the case study had problems on quality of drainage and pavement structure, which impose the roads authorities to perform emergency repairs immediately to save lives and prevent disastrous consequences of damaged infrastructure and incur unexpected cost for routine maintenance.

4.4 Findings from Reviews of International Road Projects Selection and Prioritization Practice for Investment

4.4.1 International road projects selection and prioritization practice

Taking the identified gaps in Ethiopian road projects selection and prioritization practice in to consideration relevant international practice was reviewed, and discussed in the following sections.

i. Public consultation practice in selection and prioritization of road projects investment

As it is discussed previously under literature review local communities are the main stakeholders and users of RTI. In recognition of this, there is now wide acceptance that their participation in the preparation and implementation of investment programs enhances local ownership and commitment, and fosters better accountability, management and sustainability. Due to the increasingly decentralized framework for the provision of local services, and in order to build ownership and mobilize local resources, the planning (and monitoring and evaluation) process for RTI must be participatory.

In this regard, two relevant international practices were reviewed in the literature review section (Vietnam and Tanzania) in order to observe the significance of applying participatory planning approach and its realization.

ii. Safety and Social and Environmental impact consideration in selection and prioritization of road project

As to addressing the gaps identified from Ethiopian road projects selection and prioritization practice for investment with regard to safety, social and environmental impacts, two different international practices were also reviewed, as summarized in the literature review section (Pakistan and Indonesia).

4.4.2 Comparison of domestic and international road projects selection and prioritization practice for investment

Comparison was made between the domestic and international road projects selection and prioritizations practices in order to recommend improvement action for the gaps found out on Ethiopian selection and prioritization practice. Table 4.26below summarizes the comparison of Ethiopian and international road projects selection and prioritization practice.

Table 4.26: Summary of comparisons between Ethiopian and international road projects selection and prioritization practice

Selection and Prioritization Parameters	Ethiopian Practice	International Practice	Recommendation
Public Consultation	Poor consultation practice was observed in selection and prioritization of Ethiopian road projects, according to the results of this research.	Participatory planning approach was the main method used in both case of the international road projects selection and prioritization practice.	Though participatory planning approach is potentially a time-consuming process, Ethiopian roads agencies should adopt it in order to enhance local ownership and commitment, and fosters better accountability, management and sustainability. The participation should, however, have not been to replace the economic selection process.
Safety	Safety provision is considered during the construction period, although not implemented accordingly. Safety of the roads will not be considered as prioritization criteria and the feasibility study do not consider accident costs. Hence, enough provision is not considered with regard to mitigation costs or eliminating unsafe routes from the network.	In both case of international practice review, weighting was given for those parameters in prioritizing road projects.	Although it is difficult and in a way unacceptable to place a monetary value on human life, an estimation of the loss of human health due to road accidents can be made. Accident costs can then be included in the CBA. However, this requires unit prices for road accidents and also requires traffic accident data in order to calculate the accident rate, which can in turn be calculated for the existing road and used to make a forecast for the new road. Besides, safety parameters must be considered and included in prioritization criteria and should be given its own weighting.
Social and Environmental Impact	Social and Environmental impact of the road are usually performed after selection of the roads and feasibility study is conducted. Proper attention is not given at construction stage and mitigation measures require a large		Those parameters must be considered and included in prioritization criteria and should be given its own weighting.

	amount of budget since it is not exhaustively considered at planning stage.		
Economic Evaluation	Both MCA and cost benefit analysis approaches are used. However, both criteria are not applied simultaneously.	In the review of both international practices the main economic analysis approach was cost effectiveness approach.	As observed during literature reviews, cost effectiveness analysis is a subset of MCA, and CBA methodologies is a fundamental approach to fully consider sustainability.
Sustainability	As it is observed from the result of this research, sustainability of the road is the major problem in Ethiopian road construction practice with regard to quality, construction period, and maintenance practice.	Sustainability is considered during planning of the roads with the aim of reduced project delivery delays, improving the efficiency, performance and connectivity of road network, and maintaining the road infrastructure in a state of good repair to maximize the significance of the road network.	Develop more effective and efficient methods to take forward the development and implementation of road construction and to ensure sustainable road maintenance, and consider it as criteria. Strong institutional reforms to improve its capacity, accountability and responsiveness to develop and enforce policies and regulations in the management of road construction and maintenance.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1General

The following conclusions and recommendations are forwarded based on the information acquired duringthe research work.

5.2Conclusions

In the previous chapter, the results obtained in the analysis of the interviews, document reviews, questionnaire surveys, case study and review of international practice were discussed, and based on the findings the following major conclusions have been drawn:

i. The research showed that ERA has its own selection methods and prioritization criteria for investmentof road projects. However, the study revealed that road projects that are under implementation and planned for implementation are not in line with the given selection methods (regional roads authority proposal or ERA's planning requirement). In addition, the said prioritization criteria are not practically in use, roads are not computed/ranked as per the given criteria weighting; though it is considered in feasibility studies of the project roads.
ii. The study revealed that ORA is exercising some regional/rural road projects investment prioritization criteria though it is not officially communicated or considered throughout the authority as a guideline. However there is no weighting for each criteria to evaluate all projects on equal basis.During this research, it was also noted that ORA did not consider traffic count and the existing road condition. Besides, the actual project implementationis not consistent with the road project planned rank.
iii. Both ERA and ORA roads have very low impacts on the parameters considered due to lack of public consultation and none consideration of reduced accident rate. In addition, the roads resultedin negative social and environment impact; especially,the ERA roads havesignificant negative social and environment impacts even more than the positive impacts of the roads.

iv. The study also revealed that the impacts of the ERA road projects towards improving the use of transportation activities within the communitieswere reduced as compared to the impacts observed on importance of the roads and degree of the constructed roads to support the communities' livelihoods. The major factor that minimizes the improvement of communities' transportation activities was higher rate of accident that resulted from thenewly constructed roads.

v. Regarding sustainability,the study revealed that all implementation parameters (Quality of the constructed roads, Maintenance of the roads, and Degree of compensation and affected groups level of satisfaction), especially maintenance practice has lower positive impact on the road projects effectiveness, this shows that poor implementation practice adversely influences the success of road project planning.

vi. The research revealed that the gaps identified from domestic road project selection and prioritization practice areproperly addressed and implemented in other countries; such as Vietnam, Pakistan, Tanzania and Indonesia.

vii. In addition from the study, different challenges were observed during selection and prioritization of Ethiopian road projects, and the major challenges are summarized as follows:

- Budget limitation;
- Decision makers interest;
- Rapid rate of traffic growth;
- Incidental situation;
- Regional competition;
- Excessive public demand;
- Poor maintenance practice;
- Lack of accident record;
- Road authorities, local consultants and contractors capacity problem;
- Lack of integration with other infrastructure development institutions; and
- Lack of project ex-post evaluation practice.

5.3Recommendations

Following the detailed study of the evaluation of road selection and prioritization practiceregarding federal and regionalroad projects in Ethiopia, analysis of the collected data on the same and conclusions made, recommendations are forwarded and the recommendations are presented in two groups as follows.

i. **Gaps identified on Ethiopian road projects selection and prioritization practice for investment**

- ✓ **Public consultation:**Though participatory planning approach is potentially time-consuming process, Ethiopian roads authorities should exercise it in order to enhance local ownership and commitment, and fostering better accountability, management and sustainability. The participation should not however be to replace the economic selection process.
- ✓ **Safety and Social and Environmental impact:** Those parameters must be considered and included in prioritization criteria, with weighting provision.
- ✓ **Economic Evaluation:** Since ERA has already executed most of trunk roads and link roads the criteria should mainly focus on transport cost reduction and agricultural productivity rather than on mobility and accessibility. Hence, to address such characteristics, both federal and rural roads authorities are recommended to use the integration of Multi-criteria and Cost-benefit methodologies in prioritizing road projects investment.
- ✓ **Sustainability:** to ensure sustainable road infrastructure, the following recommendation have been forwarded to be implemented by the roads authorities;
  - Develop more effective and efficient methods to take forward the development and implementation of road construction and to ensure sustainable road maintenance and this should be considered asa criteria.
  - Strong institutional reforms are required in order to improve capacity, accountability and responsiveness and also to develop and enforce policies and regulations in the management of road construction and maintenance.
- ✓ The roads authority should critically review and improve the current selection and prioritization criteriain order to address the above given recommendation and should appropriately implement it in prioritization of road projects investment.

ii. Recommendations to deal with the challenges facing the Ethiopian road projects selection and prioritization practice for investment

Based on the interview findings, suggestion given by questionnaire respondents, review of different literature and overall study findings the following recommendationsare forwarded to deal with the challenges facing the Ethiopian road projects selection and prioritization practice for investment.

- ✓ Decision makers must have technical and managerial skill that enablethem to understand the impact of their decisions on the road sector.
- ✓ Roads authorities must have enough expertise in their respective planning departments since planning is the backbone of the sector.
- ✓ Roads authorities must develop clear and appropriate compensation standards and should communicate with their respective local communities.
- ✓ Local contractors and consultants capacity building program must be improved to reduce the expense of foreign currency, quality problem and consequence of termination.
- ✓ Implementation sections must be strong in monitoring the execution of planned projects with regard to safety, quality, cost, time and implementation of social andenvironmental management plan.
- ✓ Roads authorities should improve their maintenance management practices.

5.4Proposed Future Area of Research

Based on the outcome of this study, the following research areas are proposed in order to complement and/or enhance the area.

- ✓ Developing transportation sustainability ratingsystems for implementation.
- ✓ Study the rate of accidents on newly constructed roads including the route causes of accidents.
- ✓ Establish multi-criteria decision model/s for infrastructure development.
- ✓ Comparison of cost-effectiveness analysis and cost benefit analysis for economic evaluation.

REFERENCES

1. AbdMajid& McCaffer, (1997), Assessment of Work Performance of Maintenance Contractors in Saudi Arabia, Journal of Management in Engineering.
2. A new planning process for prioritizing regional road projects for the region's road network plan and comprehensive economic development strategy, Indonesia, January 2010.
3. Appraisal reportroads rehabilitation/ upgrading project, united republic of Tanzania (August, 2009).
4. Barfod, M. B., Salling, K. B., &Leleur, S., (2011). Composite decision support by combining cost-benefit and multi-criteria decision analysis. Decision Support Systems, 51(1), 167–175.
5. Berechman, J., (2009). The Evaluation of Transportation Investment Projects. New York, New York, USA: Routledge.
6. Beria, P., Maltese, I., &Mariotti, I., (2011). Comparing cost benefit and multi-criteria analysis: the evaluation of neighbor hoods' sustainable mobility, (pp. 1 – 26).
7. Black, W. R., (2010). Sustainable Transportation Problems and Solutions. New York: The Guilford Press.
8. ERA, (2015). Borrower's Implementation Completion Report.
9. Bots, P. W. G., &Lootsma, F. A., (2000). Editorial: Decision Support in the Public Sector. Journal of Multi-Criteria Decision Analysis.
10. Browne, D., & Ryan, L. (2011). Comparative analysis of evaluation techniques for transport policies. Environmental Impact Assessment Review, 31(3), 226-233.
11. Carol Gosenheimer, (2012). Project Prioritization Guide V, Version 1.1. The Office of Quality Improvement University of Wisconsin-Madisonn
12. Carnemark, C. Biderman, J., and Bovet, D., (1976). The economic analysis of rural road projects. World Bank, Staff Working Paper No. 241. Washington, DC: World Bank.
13. CEM., (2008a). Sustainability and the built environment. United Kingdom: The College of Estate Management.
14. Colin Booth, F. H., Jessica Lamond, David Proverbs, (2012). Solutions to Climate Change Challenges in the Built Environment. Oxford: Blackwell Publishing Ltd.
15. Bekele Nigussie, (2004). Contribution of BekeleNegussie in the Revision of ORN 5, (July 17, 2004, Addis Ababa, Ethiopia).
16. Damart, S., & Roy, B., (2009). The uses of cost–benefit analysis in public transportation decision-making in France. Transport Policy, 16(4), 200-212.

17. ERA,(2016). GTP I Plan Five years (2003-2007) and EFY 2007 Performance Report.
18. ERA, (2016). GTP II Plan, 2008 EFY.
19. ERA design manual, 2002
20. Gamper, C. D., &Turcanu, C., (2007). On the governmental use of multi-criteria analysis. Ecological Economics, 62(2), 298-307.
21. Gühnemann, A., Laird, J. J., &Pearman, A. D., (2012). Combining cost-benefit and multi-criteria analysis to prioritize a national road infrastructure programme. Transport Policy, 23, 15–24.
22. Haezendonck, E., (2007). Transport Project Evaluation: Extending the Social Cost-Benefit Approach. Northampton, Massachusetts, USA: Edward Elgar Publishing Inc.
23. Hayashi, Y., &Morisugi, H., (2000). International comparison of background concept and methodology of transportation project appraisal. Transport Policy, 7(1), 73-88.
24. Hill, M. (1968). "A Goals Achievement Matrix for Evaluating Alternative Plans." Journal of the American Planning Association, 34(1), 1929.
25. Hollick, M., (1986). Environmental impact assessment: An international evaluation. Environmental Management, 10(2), 157–178.
26. Hine, J., Authority, E.R., & Ababa, A. (2003). Are Social Benefits the Missing Component of Road Appraisal Planning.
27. Jones, H., Moura, F., &Domingos, T., (2014). Transport Infrastructure Project Evaluation Using Cost-benefit Analysis. Procedia - Social and Behavioral Sciences, 111, 400-409.
28. John Howe, (2001). Assessing the Impact of Transport Infrastructure on Poverty Reduction.
29. Jones, S., Tefe, M., and Appiah- Opoku, S. (2013). "Proposed framework for sustainability screening of urban transport projects in developing countries: A case study of Accra, Ghana." Transportation Research Part A: Policy and Practice, 49, 21-34.
30. J. Lebo and D. Schelling, World Bank, (2001). Rural Road Economic Appraisal Methodology.
31. Jørgensen, A., Bocq, A., Nazarkina, L., &Hauschild, M., (2007). Methodologies for social life cycle assessment. The International Journal of Life Cycle Assessment, 13(2).
32. Karvetski, C. W., Lambert, J. H., and Linkov, I. (2009). Emergent conditions and multiple criteria analysis in infrastructure prioritization for developing countries." Journal of Multi-Criteria Decision Analysis, 16(5-6), 125-137.
33. Lebo, J. and Schelling, D., (2001) Design and Appraisal of Rural Transport Infrastructure. World Bank Technical Paper No.496. Washington D.C: World Bank.

34. Liu, Z., and Smith, G. (2006). "China: Building institutions for sustainable urban transport."
35. Litman, T. (2003). "Sustainable transportation indicators." Victoria Transport Policy Institute, 100.
36. Mak, K. K. (1973). "Priority Analysis for Ranking of Transportation Improvement Projects - A Proposed Procedure," Georgia Institute of Technology, Atlanta, GA.
37. M.BENMAAMAR, October 2012, A method for appraisal of low volume roads in Vietnam.
38. Nickel, J., Ross, A. M., & Rhodes, D. H., (2009). *Comparison of Project Evaluation Using Cost-Benefit Analysis and Multi- Attribute Trade space Exploration in the Transportation Domain*. Paper presented at the Second International Symposium on Engineering Systems, MIT, Cambridge, Massachusetts.[Online], Available:http://esd.mit.edu/symp09/submitted-papers/nickel-paper.pdf [21 November 2016].
39. ORA,(2016). GTP I (2003-2007 EFY) Evaluation Report.
40. ORA,(2016). GTP II Plan, 2008 EFY.
41. ORA, (2012). Oromia Region Road Network Master Plan Study.
42. Oswald, M. R. M., Sue, (2010). Rating Sustainability: Transportation Investments in Urban Corridors as a Case Study. Journal of Urban Planning and Development © ASCE, 177-185.
43. Pakistan Road Sector Development Program, Performance Evaluation Report, March 2016.
44. Planning and Environmental Impact Assessment of Road Infrastructure, Republic of Botswana Road Department, (Guideline No. 05, September 2001)
45. Preston, J., (1996). Transport Research APAS Strategic Transport VII-15: Cost Benefit Analysis and Multi-Criteria Analysis for Rail Infrastructure. Luxemburg: European Commission: Directorate General Transport.
46. ERA, (2016). EthiopianRoad Sector Development Program, 19 Years Performance Assessment Reports.
47. ERA, (2010). EthiopianRoad Sector Development Program, 13 Years Performance Report.

48. Saaty, T.L. & Tran, L.T., (2007). On the invalidity of fuzzifying numerical judgments in the Analytic Hierarchy Process. Mathematical and Computer Modeling, 46(7-8), pp.962–975.
49. Sahadev B., Padma B.S, and Rabindra N., (2009). Multi-criteria Evaluation for RankingRural Road Projects: Case study of Nepal. [Online], Available:http://www.iosrjournals.org[28 February 2017].
50. Saitua, R., (2007). Some considerations on social cost-benefit analysis as a tool for decision making. In E. Haezendonck (Ed.), Transport Project Evaluation: Extending the Social Cost-Benefit Approach (pp. 23-33).
51. Salling, K. B., & Banister, D., (2009). Assessment of large transport infrastructure projects: The CBA-DK model. Transportation Research Part A: Policy and Practice, 43(9-10).
52. ShafiqulAlam, Arun Kumar and Les Dawes), (2013). Life Cycle Analysis for Sustainability Assessment of Road Projects.
53. TamiratFikre, (2014). Multi-Criteria Decision Modeling for Infrastructure Development: A case of Ethiopian Highway Rehabilitation Projects.
54. Thomopoulos, N., Grant-Muller, S., & Tight, M. R., (2009). Incorporating equity considerations in transport infrastructure evaluation: Current practice and a proposed methodology.
55. ERA, (2007).Transport and Poverty Observatory Study.
56. Tsamboulas, D. A., (2007). A tool for prioritizing multinational transport infrastructure investments. Transport Policy.
57. Turochy, R. E., and Willis, J. R. "Procedures for prioritizing transportation improvements at the metropolitan level." Transportation Research Board 85th Annual Meeting, Washington, D.C.
58. Worku, I. (2011). Road Sector Development and Economic Growth in Ethiopia. Ethiopia Support Strategy Program II, International Food Policy Research Institute, Addis Ababa, Ethiopia.
59. www.surveygizmo.com[14 Aug 2017], create and report using Likert Scale.
60. Yeh, C.-H., Willis, R. J., Deng, H., & Pan, H., (1999). Theory and Methodology: Task oriented weighting in multi-criteria analysis. European Journal of Operational Research, 119(1), 130-146.

61. Ziara, M., Nigim, K., Enshassi, A., and Ayyub, B. M. (2002). "Strategic implementation of infrastructure priority projects: case study in Palestine." Journal of infrastructure systems, 8(1), 2-11.
62. ERA, (2016). 2nd Year Survey Report for the Impact of Rural Roads Constructed under URRAP.

APPENDICES

Appendix – 1 Definition

Access: Way whereby the owner or occupier of any land has access to a public road, whether directly or across land lying between his hand and such public land.

Asphalt Concrete: A mixture to predetermined proportions of aggregate, filler and bituminous binder material plant mixed and usually placed by means of a paving machine.

Average Annual Daily Traffic (AADT): The total yearly traffic volume in both directions divided by the number of days in the year.

Benefit Cost Ratio (**B-CR):**is the ratio of discounted benefits to discounted costs at the opportunity cost of capital. A project is said to be viable when B-CR is greater than one.

Design Capacity: Maximum number of vehicles that can pass over lane or a roadway during a given time period without operating conditions falling bellow a pre-selected design level.

Design Period: The period of time that an initially constructed or rehabilitated pavement structure will perform before reaching a level of deterioration requiring more than routine or periodic maintenance.

Diverted Traffic: Traffic that changes from another route (or mode of transport) to the project road because of the improved pavement, but still travels between the same origin and destination.

Double Bituminous Surface Treatment: The sealing or resealing of the carriageway or shoulders by means of two successive applications of bituminous binder and crushed stone chippings.

Economic Analysis: is the analysis of economic parameters that helps to determine projects' viability and contribution to developments. Evaluation of investment alternatives from economic view requires consideration of the initial investment, cash inflows and outflows, depreciation and taxes over the economic life of the proposed assets in the project.

Generated Traffic: Additional traffic which occurs in response to the provision of improvement of the road.

Internal Rate of Return (IRR): is an economic parameter used to determines the break-even rate of return showing the discount rate below which an investment results in a positive NPV (and should be made) and above which an investment results in a negative NPV (and should be avoided).

International Roughness Index(**IRI**) is the roughness index most commonly obtained from measured longitudinal road profiles. It is calculated using a quarter-car vehicle math model, whose response is accumulated to yield a roughness index with units of slope (in/mi, m/km, etc.).

Link Road: National road linking nationally important centers

Maintenance: Routine work performed to keep a pavement as nearly as possible in its as-constructed condition under normal conditions of traffic and forces of nature.

Mitigating measure: Practical measures to reduce the adverse impacts or enhance the beneficial impacts of an action.

Net Present Value (NPV): is the difference between the discounted value of benefits and the discounted value of costs and at the opportunity cost of capital. Net present value (NPV) considers the time value of money for the whole life of projects (lifecycle costs).

Normal Traffic: Traffic which would pass along the existing road or track even if no new pavement was provided.

Project Stakeholders:are entities that have an interest in a given project. These stakeholders may be inside or outside an organization which: sponsor a project, or have interests or a gain upon a successful completion of a project; may have a positive or negative influence in the project completion.

Rehabilitation: Work undertaken to significantly extend the service life of an existing pavement. This may include overlays and pre overlay repairs, and may include complete removal and reconstruction of the existing pavement, or recycling of part of the existing materials.

Road Transport: means transportation of goods and personnel from one to the other on roads. It offers a complete freedom to road users to transfer their vehicle from one lane to the other and from one road to another according to the need and convenience. It is flexible and

its flexibility of changes in location, direction, speed, and timings of travel is not available to other modes of transport. It is possible to provide door-to-door services.

Sustainable development: Development, which satisfies the needs of the present generation without in any way putting in jeopardy the needs of future generations.

Terms of Reference: Written requirements governing EIA implementation and its objectives, consultation to be held, data to be produced and form and contents of the Report. Often produced as an output from scoping. Abbreviated to ToR.

Traffic Volume

Volume of traffic usually expressed in terms of average annual daily traffic (AADT).

Trunk Road: International trunk road linking centers of international importance and crossing international boundaries or terminating at international port.

Transport Planning: Literature defines Transport planning as planning required in the operation, provision and management of facilities and services for the modes of transport to achieve safer, faster, comfortable and convenient, economical and environment friendly movement of people and goods.

Appendix – 2 Interview Questions

1. How does the roads authority identify road projects?

2. Does the roads authority verify that the identified road projects on regional/zonal level have been selected based on an appropriate criterion?

3. Does the roads authority directly consult the community when/before selecting the projects?

4. How does the roads authority confirm the public needs?

   Does the roads authority perform its own public need assessment regarding roads demand?

5. What technique, criteria, or method does the roads authority use to prioritize the identified road projects?

6. How long those criteria have been used to prioritize road projects in the authority?

7. Are all projects at hand prioritized using those criteria?

   If not, Why?

8. Are there any gaps/challenges the road authorities face while implementing the criteria?

   If yes,
   - What are the gaps/challenges and how critical are they?
   - Is there any plan to improve the criteria as to reduce/avoid the impact of such challenges?

9. Does the roads authority post-evaluate the constructed road projects?

   If yes, do the finding show that the roads are giving the desired function?

   If not,
   - Why?

   - Does the roads authority try to re-evaluate the criteria in this regard?

10. Does the roads authority evaluate that the constructed road projects are giving positive economic impact as planned?

    If yes,
    - How are they evaluated?

- What are the findings?

11. How does the roads authority make a feedback assessment from public and other departments on the constructed/under construction road projects?

    Does the roads authority try to re-evaluate the criteria accordingly?

12. Do constructed roads perform as anticipated until the end of their lives?

    If not,
    - What are the reasons?
    - How does the roads authority manage/address such challenges?

13. Does the public collaborate with the roads authority for the successful implementation of road construction projects?

    If not,
    - Why?
    - Does the roads authority try to address such issues in the future projects? How?

14. Is there any means of communication with other sectors and ways of integration between regions and road agencies?

    If not,
    - Are there any challenges resulted due to lack of integration?
    - Does the roads authority plan to fill such gaps?

15. Does the roads authority re-evaluate the criteria in a specific time interval?

    If yes,
    - What are the findings?
    - What kind of improvements has been made?

16. Does the roads authority believe that the desired targets are achieved according to the original plans of road projects?

    If not, why?

17. Any additional opinions or suggestions in this regard …… ……

Appendix – 3 Questionnaire

1. General Background Information

The questions below are related to your organisation and yourself. Please indicate your response by ticking (X or √) the appropriate box (es) or by filling the blank spaces provided, as appropriate.

1.1 Institution/Society you are representing:

- ☐ Zone's Transport Office
- ☐ Town/ Woreda's Transport Office
- ☐ Zone's Adminstrative Office
- ☐ Town/Woreda'sAdminstrative Office
- ☐ Community

1.2 Your Location, Age and Occupation:

- ☞ Location/Area of Residence: _____
- ☞ Age: _____
- ☞ Occupation: _____

2. Choosing the factors that are considered in the road project selection and prioritization process

Please consider the questions in terms of your experience and/or your knowledge, the degree of consideration of the following factors in the road projects prioritization practice and respond by ticking in (X or √) the appropriate box or filling the blank space provided, as appropriate. For otherfactors which require specific elaborations, please reply to the subjective questions in the space provided.

2.1 How are road projects identified for implementation or included in the road network? (forroads agencies only)

2.2 Do the road agencies consult the public while identifying the road projects?

☐ Significantly ☐ Partially ☐ Not at all

2.3 If your answer for Q. 2.2 is not at all, please mention your comments.

_____

_____

2.4 Do the road agencies use any mechanism to convey the public interest regarding the road network to the roads authority or to respective offices?

☐ Significantly ☐ Partially ☐ Not at all

2.5 If your answer for Q. 2.4 is significantly or partially, please specify way of consultation.

_____

_____

2.6 Do the constructed/serviceable roads important for the public?

☐ Significantly ☐ Partially ☐ Not at all

2.7 If your answer for Q. 2.6 is partially or not at all, what do you think the possible reasons? (You may choose more than one).

☐ Inconsistent with the local people need/interest.

☐ Do not provide intermodal accesses

☐ Lack of connectivity with the overall transportation network.

☐ Lack of passenger cars and trucks freight movement.

☐ Do not promote tangible and sustainable growth on the community's livelihood

☐ If any other, please specify_____

2.8 How many of the constructed roads support the community's livelihood?

☐ Significantly ☐ Partially ☐ Not at all

2.9 If your answer for Q. 2.8 is significantly or partially, which of the following factors affect the community's livelihoodin positive way? (You may choose more than one).

☐ Increase crop production and provide easy market access to the community

☐ Facilitate and support trade market within the road influence area

☐ Increase access to school, health center and other services

☐ Increase zonal and regional connectivity

☐ If any other, please specify_____

2.10 Do the constructed roads improve use of transportation within the community?

Significantly ☐ Partially ☐ Not at all ☐

2.11 What is your opinion on the following factors those improves the community's transportation practice?

Description of Factors	Significantly	Partially	Not at all
Sufficient transport vehicles			
Reduced transportation cost			
Reduced travel time			
Reduced accident rate			

2.12 If your opinion in reduced accident rate is not at all in Q. 2.11, to which one of the following problems is the reason related?(You may choose more than one).

☐ Lack provision of safety and other facilities for pedestrian

☐ Poor quality of the constructed road

☐ Lack of routine and periodic maintenance or rehabilitation

☐ Lack of awareness on the road user

☐ Any others, please specify_____

2.13 Do you believe that the constructed roads fulfill the desired quality?

☐ Significantly ☐ Partially ☐ Not at all

2.14 If your answer for Q. 2.13 is partially or not at all, please mention your comments.

_____

_____

2.15 Do you believe that he constructed roads maintained periodically?

☐ Significantly ☐ Partially ☐ Not at all

2.16 One of the major issues during implementation of road construction project is right of way obstruction removal. Do the public satisfied on the compensation for removal of their property from the road section?

☐ Significantly ☐ Partially ☐ Not at all

2.17 Do the constructed road affects social or environmental patterns of the project areas?

☐ Significantly ☐ Partially ☐ Not at all

2.18 If your answer for Q. 2.17 is significantly or partially, to which one of the following problems is the reason related?(You may choose more than one).

- ☐ Cause of flood
- ☐ Cause of landslide
- ☐ Cause of cutting huge amount of trees and cultural heritagedamage
- ☐ Cause of resettlement for a large group of peoples
- ☐ Any others, please specify_____

2.19 What do you suggest as measure to improve the road identification and prioritization processes in the future?

_____
_____
_____

2.20 Other comments you may forward with regard to the subject matter.

_____
_____
_____

Appendix – 4 Analysis of Questionnaire Response